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Vol. III, Part 1.

UPPER TRIASSIC CEPHALOPODA FAUNÆ OF THE HIMÁLAYA.

By Dr. EDMUND MOJSISOVICS, EDLEM VON MOJSVÁR,
Member, Imperial Academy of Science, Vice-Director, K. K. Geologische Reichsanstalt, Vienna.

TRANSLATED BY
DR. ARTHUR H. FOORD, F.S.G., AND MRS. A. H. FOORD.

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VIENNA.

Translated[1] *by*

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INTRODUCTION.

In the preliminary communication on the Cephalopod Faunæ of the trias of the Himálaya,[2] published four years ago, the reasons were given which induced the Imperial Academy of Vienna to suggest to the Geological Survey of India the promotion of a special expedition to the Himálaya for the collection of trias fossils, and to participate therein by sending as their representative Dr. Carl Diener, to whom a considerable grant was made from the Boué fund of the Academy. The Imperial Indian Government sanctioned a sum slightly exceeding that given by the Academy for the expenses incurred by Dr. Diener, and ordered Messrs. C. L. Griesbach and C. S. Middlemiss, of the Geological Survey of India, to join the expedition. The success of the expedition was in this manner assured, and on May 27th, 1892, the journey from Naini Tál to the mountains was begun. The participation of Mr. Griesbach, who was placed in official charge of the expedition, was of great assistance, and the remarkable results arrived at are due to his great local knowledge, capacity and energy, and not less to the skill and perseverance of Dr. Diener, whose familiarity with high mountains, gained in his numerous tours in the European Alps, was of invaluable help. The expedition which, in order to reach the region of their work, on the north side of the mountains, had to cross the principal chain of the Himálaya on their journey going and returning, came back to their starting place in Naini Tál on October 7th.

Besides Dr. Diener's detailed account, presented to the Academy and published in the memoirs of the Academy[3] under the title "Ergebnisse einer geologischen Expedition in den Central Himálaya von Johar, Hundes und Painkhanda," there are several smaller communications by Dr. Diener on the particulars of the journey, on geographical conditions and on glacial phenomena,[1] to which references are here given to avoid repetition.

---

[1] The German original was published in Vol. LXIII. of the Denkschriften der Kais. Akademie der Wissenschaften in Wien, 1896.

[2] Sitzungsber. d. mathem.-naturw. Cl. Bd. CI. Abth. I, p. 372.

Bd. LXII. (1895), pp. 533-608.

The results of the expedition were very satisfactory, though, on account of the shortness of the time, the original plans could not all be carried out. The rich collections of fossils which were made in some favourable places enable us now to look deeper into the character of the individual faunæ, especially those of the triassic and jurassic periods.

The great bulk of the material of the Dinaric and Scythian series was the cause of my abandoning my original plan to work up all the cephalopod faunæ of Himálayan trias, after having found a thoroughly able worker for the Cephalopoda of the above-named series in Dr. Diener,[2] who worked indefatigably in collecting. I was then able to confine myself to the investigation of the upper triassic Cephalopoda of the Tyrolese and the Bajuvarian Series, which is especially interesting as it represents, for the most part, completely new material.

The first discoveries of Cephalopoda in the trias system of the Himálaya were made at a time when valid distinctions in Cephalopod horizons in our Alps could not yet be made, when the species of Cephalopoda later recognized as peculiar to the Muschelkalk were attributed to the Buntsandstein, and when the definition of species was still so extraordinarily comprehensive that the latter often reached the rank of the genera of the present day; sometimes, as, for example, in "*Ammonites Aon*" even over-stepping it. It is therefore not surprising that the first interpretations of the triassic Ammonites of the Himálaya did not rise above general statements, and that the designations of the species, according to the knowledge of that time, gave the widest latitude to the author's own conceptions. Nevertheless it must be regarded as an advancement in knowledge that the considerable analogies existing between the triassic faunæ of the Himálaya and those of the Alps should have found their expression in a parallelism with the Alpine formations. It must even be admitted that, according to the state of knowledge at the time, the allocation of the fossil-bearing triassic limestone of the Rajhoti Pass in Niti to the upper Alpine trias was perfectly justifiable. The credit of the discovery of these first Himálayan trias fossils is due to Captain (afterwards General) R. Strachey, who published[3] in the year 1851 an account of his geological investigations in the neighbourhood of the Niti Pass. Ed. Suess, who in the year 1862 had an opportunity of seeing the Strachey Collection in London, drew attention to the great similarity of some of its forms to Alpine species[4] and pointed out the importance of the above account. The descriptions and figures were then made by J. W. Salter and published in association with H. F. Blanford in the "Palæontology of

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[1] Verhandl. der Gesellschaft für Erdkunde in Berlin, 1893, Nr. 6, Zeitschrift des deutschen und österreichischen Alpenvereines, 1895, pp. 269-314, and Mittheilungen der k. k. Geographischen Gesellschaft in Wien, 1896, pp. 1-85.

[2] Dr. Diener has in the meantime finished the working out of the Cephalopod faunæ put into his hands, and the fauna of the Muschelkalk (Anisic Stage) has already appeared (Palæont. Indica, ser. XV., Himálayan Fossils, Vol. II., Trias, Part 2). The faunæ of the Scythian Series is in the press.

[3] Quarterly Journ. Geol. Soc., London, 1851, pp. 292-310.

[4] Jahrb. d. geol. Reichsanst., 1861-62, Verh. p. 258.

Niti in the Northern Himálaya."[1] My distinguished countryman, Ferd. Stoliczka, who, in 1864, accompanied by F. R. Mallet, travelled through Spiti, and has in his well-known memoir[2] given a detailed description of the fossils collected in the so-called "Lilang Series", declared this series to be likewise upper triassic on the ground of the above observations, and pronounced them to be the equivalent of the Hallstatt and St. Cassian beds. A number of the fossils mentioned by Stoliczka are identical with the species described by Salter from the vicinity of the Niti Pass. Stoliczka considered it very remarkable that "*Ammonites Aon*" occurring in Niti had not been found in Spiti.

Meanwhile considerable progress had been made in the knowledge of the geology of the Alps. D. Stur stated concerning the set of fossils collected in Lombardy by A. Escher v. d. Linth and preserved in the Museum at Zurich, that the Cephalopoda of Dont, Cencenighe and Val Inferna, hitherto attributed to the Buntsandstein[3] by Fr. von Hauer, occur in black limestone with fossils of the Muschelkalk, and consequently were to be regarded as Cephalopoda of the Alpine Muschelkalk.[4] As a result of this suggestion Fr. von Hauer recently undertook an investigation[5] of the Cephalopoda of the lower trias and distinguished, besides the lower Cephalopoda horizon, another Cephalopod fauna of the Alpine Muschelkalk. Simultaneously with Fr. von Hauer, E. Beyrich[6] also occupied himself with the Cephalopod fauna of the Alpine Muschelkalk, of which he had received a number of very beautiful specimens from Reutte through the labours of Mr. Kutschker.

In these works both Fr. v. Hauer and Beyrich seized the opportunity of giving their views upon the Cephalopoda of the Himálayan trias, upon which Oppel also had published a memoir.[7] Both pointed out the close relationship of the Indian forms to those of the species of the Alpine Muschelkalk, which was also recognised by Oppel. Beyrich specially affirmed with great confidence that the Cephalopoda known up to the present time from the Himálayan trias, provided that they all came from the same beds, represented a fauna of the Muschelkalk and not of the Keuper.

From this time the Cephalopod-bearing triassic limestone of the Himálaya was regarded as Muschelkalk, and there was a danger of the existence of a later Cephalopod fauna within the Himálayan region being doubted. It was left to the present energetic Director of the Geological Survey of India, Mr. C. L. Griesbach,[8] to prove by careful contour surveys that there are, in the trias of the Himálaya, several sharply circumscribed Cephalopod horizons, not only above, but also below the Muschelkalk. The fossils collected in these researches and sent to Vienna, to be worked up, indicated the existence of upper triassic localities, very rich in Cephalopoda, which were sufficient to encourage the undertaking of the above-mentioned Himâlayan expedition.

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[1] Calcutta, 1865.

[2] Geological Sections across the Himálaya Mountains. Mem. Geol. Survey, India, Vol. V, Part I.

[3] Palæont. Notizen. Sitzungsber. d. kais. Akad. d. Wiss. Mathem.-naturw., Cl. XXIV. Bd. 1857, p. 145.

[4] Jahrb. d. geol. Reichsanst., 1865, Verh. pp. 158, 245.

[5] Die Cephalopoden der unteren Trias der Alpen. Sitzungsber. d. kais. Akad. d. Wiss. Mathem.-naturw. Cl. LII. Bd. 1865, 7 December.

[6] Abhandl. d. Königl. Akad. d. Wiss. Berlin, 1866, pp. 105-179.

[7] Uber ostindische Fossilreste. Palæontol. Mittheil. Bd. I., pp. 267-302 (1863-65).

[8] Records Geol. Survey of India, Vol. XIII, Part 2, p. 94. Memoirs Geol. Survey of India, Vol. XXIII, Geology of the Central Himaláyas.

The following may be regarded as probably upper triassic forms, which together with Muschelkalk species, were described by Salter and Stoliczka :—

1. *Trachyceras*, sp. (Group of *Trach. duplica*) = *Ammonites Aon*, Salter, Palæont. of Niti, pl. VII, fig. 6.
2. *Arpadites Stracheyi* = *Ammonites Floridus*, *juv.*, Salter, l. c. pl. VIII, fig. 3.
3. *Hungarites nitiensis*, the keeled shells distinguished by Salter as young forms of *Amm. Floridus*, l. c. fig. 1, a-e of pl. VIII.
4. *Griesbachites Medleyanus*, Stol.
5. *Cladiscites indicus*, Mojs. (= *Amm. Gaytani*, Stol.)
6. *Isculites Hauerianus*, Stol.
7. *Lobites Oldhamianus*, Stol.[1]

Of these forms, those coming from the Niti Pass may occur in the crinoidal limestone with *Trachyceras tibeticum*, but the others in the so-called Daonella beds. From the character of the rock this may be tolerably certain for Nos. 4 and 5, but there is still a possibility that Nos. 6 and 7 were collected in the Anisic limestone,[2] but Dr. Diener, as also myself, think it more probable now that they occur in the Carnic beds (either in the crinoidal limestone with *Trachyceras tibeticum*, or in the so-called "Daonella beds").

I have spoken of the few cephalopod remains, collected by Griesbach from the upper triassic beds, in the above-cited preliminary communications. Griesbach remarked then in a letter[3] directed to me that the limestone of Kalapani with Tropites, formerly termed by him "Lias," occurs in a mountain region tectonically extremely disturbed, in which probably the conditions of the deposits were not correctly understood. The palæontological determinations alone were, therefore regarded as adequate. Unfortunately the expedition of 1892 did not succeed in finding in the sections examined these Tropites limestones, which are thus only known in Griesbach's first locality, near Kalapani, so that, for the present, we are still confined to the palæontological results with regard to this important and interesting horizon.

Besides the meagre older material of Strachey, Stoliczka and Griesbach, the following descriptions of species are based upon the rich material gathered by the expedition of the year 1892. Five faunally characteristic horizons are to be distinguished which will be spoken of more in detail in the last chapter.

Moreover, two ammonites, not occurring in the Himâlaya, are included in the present work. These are a *Didymites* from Baluchistan[4] and a *Stenarcestes* from New Caledonia.

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[1] The species mentioned under Nos. 4-7 were indicated by me in the "Vorläufigen Bemerkungen" (Sitzungsber 1892) as already pointing to Upper triassic deposits.

[2] For this reason Nos. 6 and 7 were also included in Diener's "Monograph of the Muschelkalk" (Palæontologia Indica, Ser. XV., Himâlayan Fossils, Vol. II, Part 2, pp. 39, 82.)

[3] Anzeiger d. Kais. Akad. d. Wiss. Mathem.-naturw., cl. 1892, p. 174.

[4] The author has described this form as coming from Afghanistan; this is a mistake. It was found in a loose block about 7 miles south of Hindubagh in Baluchistan.—*C. L. G.*

AMMONEA TRACHYOSTRACA.

A. TROPITOIDEA.[1]

a. HALORITIDÆ.

I **Halorites**, E. v. Mojs. Cf. E. v. Mojsisovics, Die Cephalopoden der Hallstätter Kalke, Bd. II, p. 11.

The species of *Halorites* from the trias of the Himálaya belong, without exception, to the group of *Halorites acatenati.* The tuberculation which, transitory and very slightly indicated, was observed in a few Hallstatt species from the group of Acatenati, could not be observed in any of the Indian species of *Halorites* examined.

The Indian species, which in the adults are distinguished by a widely expanding last whorl and a rounded periphery, are connected through these features, in the first place with *Halorites suavis* and *Halorites mitis* from the Hallstatt limestones.

In the greater number of European species the periphery of the peristome is rectangular, the rounded periphery of the peristome is found only in the two above-named species, which, on account of their relationship to the Indian *Halorites* might be regarded as Indian types among the European *Halorites.* The rounded periphery of the peristome occurs further in the genus *Jovites*, which, owing to its widely expanding last whorl, possesses a great morphological similarity to the Indian species of *Halorites*, and is distinguished from these chiefly by the fact that the sutures are in a lower stage of development. The Indian species of *Halorites* have sutures which completely agree with those of the European species of *Halorites* and show like these three large principal saddles, whilst only two large principal saddles and a slighter indentation of all the sutural elements are to be observed in the genus *Jovites.* As *Jovites* is also the geologically older type, the suggestion might be made as to whether *Jovites* might not be considered as the ancestor of *Halorites.* It appears to me however more probable, considering that *Jovites*, to judge by its expanded body-chamber, has already entered upon a senile stage, that there exists between *Halorites* and *Jovites* a mere collateral relationship, and that both types might be traced back to a common primitive stock, which is as yet still unknown.

The sutures of our Indian *Halorites* show especially the greatest resemblance to those of the European *Acatenati.* Very remarkable is the feature, repeatedly observed, in the Indian specimens, that the last septa, which immediately precede the body-chamber, appear to be very much reduced in height, as well as in other features; thus the lobes have become short, the saddles truncated, so that the suture-line, which at one time showed Haug's euryphyll type, has now entered the stage of the stenophyll type. *Halorites semiplicatus*, appearing isolated in the Hallstatt limestone, has a suture-line showing great similarity to the degenerate suture-line of the Indian species of *Halorites*, and it is moreover to be observed that the lobes of *Halorites semiplicatus*, as they are seen in the last septum, immediately behind the body-chamber, are probably likewise degenerate. Also the suture-line of *Halorites superbus*, reproduced[1] by Haug, is perhaps already shortened by degeneration, and cannot be regarded as the type of the suture-line of *Halorites*.

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[1] In order to attain a conformity with the divisions of the Scythian, Jurassic and Cretaceous Ammonites I found myself obliged to give a higher rank to my groups, by raising families into groups and sub-families into families.

In my opinion too great a significance must not be attached to the deep indentations of the sutures of *Halorites*, and I cannot agree with Haug in considering this feature, together with the tuberculations of the catenate *Halorites* important enough to raise *Halorites* to the rank of the type of a special family—Haloritidæ—and to place it in his division of monacanthic (lanceolate) Glyphioceratidæ, whilst *Jovites* and the rest of my Haloritidæ, together with the Tropitidæ, are regarded as belonging to the family Tropitidæ, and placed in the division of the triænedic Glyphioceratidæ.[2] I look upon the deep indentations of the sutures of *Halorites* as a gradual and singular deviation from the type of the sutures of the Tropitidæ found in the dolichophyll stage. A slight sharpening of the points of the lateral lobes and of the external (siphonal) lobe is sufficient to produce the deep indentations of the *Halorites* lobes. As *Halorites* belongs to the youngest members of the Tropitidæ, I can only see in the greatly indented and well-differentiated lobes of this genus the highest degree of development which the lobes of the Tropitidæ have reached. Also in the family of the Ceratitidæ highly developed sutures sometimes show a similarly striking length of the points of the lobes. I specially refer to the lobes of *Trachyceras Aonoides* (Ceph. d. Hallst. K. II. Band, Taf. CXCI., Fig. 2). Also in a few species of the genus *Distichites*, provided with highly developed dolichophyll lobes, there occurs in the lateral lobes a stronger indentation of the point of the middle lobe. But of how little use the feature referred to is for classificatory purposes is best shown by the circumstance that even some typical forms of the group *Halorites catenati*, as for example, *Halorites catenatus* and *Halorites Alexandri*[3], possess bifid-divided lateral lobes, as in many species of *Sagenites*.

Furthermore, tuberculation of *Halorites* is also not in favour of a complete isolation of *Halorites*, as it is only confined to the group of *Catenati*, and can in this only be considered as a transitory stage, which disappears again in advanced age.

Finally, if Haug intends to trace back his family Haloritidæ to the carboniferous genus *Pericyclus*, while *Jovites* and *Juvavites* with the remaining Tropitidæ are regarded as descendants of *Gastrioceras*, only a few would be of his opinion, as the near relationship of *Halorites*, *Jovites* and *Juvavites* would be recognised by most palæontologists who, without prejudice in favour of certain theories, are engaged in a more minute investigation of these genera.

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[1] Bull. de la Soc. Geol. de France, 1894, p. 398.

[2] The name Glyphioceratidæ is a synonym for my name *Trachyostraca*, which has the priority.

[3] Compare the figures of them. Ceph. d. Hallst. Kalke. Bd. II Taf. LXXIV, Figs. 1, 2

To come back to the sutures: it seems to me that their classificatory significance, which I have never denied, is considerably overrated by some of the more recent authors. How uncertain a guide the sutures are in the systematic division of the Ammonites, and how much scope they offer to the arbitrary judgment and the personal ideas of authors, is shown by the recent attempts at a classification of the triassic Ammonites by Haug and von Zittel, both of whom attach a systematic value almost exclusively to the sutures, and nevertheless, come to conclusions in which they differ considerably from each other. I do not intend entering upon a detailed criticism, but will only mention that the classification made by von Zittel[1] which, with complete disregard to the length of the body-chamber, makes use exclusively of the development-stage of the sutures as a criterion, relies upon simple horizontal sections through different stages of development, by which genetically diverging types are put together into families, and genetically connected types are distributed in other families. Hyatt's classification of the Goniatites, which I have mentioned in the foot-note, p. 1, of the second volume of the Hallstatt Cephalopoda, is based on similar conjectures. A certain originality cannot be denied to Haug's attempt at classification. Haug tries, namely, with reference to the *Leiostraca*, as well as the *Trachyostraca*, to form a conception as to their relationship from the primitive form of the sutural extremities, according as they may be one-pointed (monacanthic), two-pointed (dicranidic,) three-pointed (triænidic), or ceratitic (prionidic), and distinguishes in each of the two large chief divisions groups based only on the character of the sutural extremities. The consistent carrying out of this scheme, however, would lead in practice to very unnatural dismemberment on the one hand, and to fusion on the other, not to mention the fact that two such forms of suture are not really found united in the same individual. I can also see in these forms of suture only stages of development which follow one another in the different groups at different times, or also run partly for a time side by side.

All our attempts at classification have still too much the stamp of artificial construction and personal conception. I do not see any reason in this circumstance to give up such attempts, but I wish to emphasize again the fact that we are still very far from a natural grouping. The source of the principal mistake, which is so often repeated, lies in putting stress upon a single feature, which through an arbitrary conception, is regarded as the most important one, although experience has often taught that the same features may not seldom be found repeated in different groups, either at the same time, or at different times. It must not therefore be overlooked that the separation of branches and twigs of one and the same stem, which in their totality form a natural family, can be differentiated more or less in their more important features. Some branches may be kept back in their development, and retain their old features, while other branches, closely related genetically, acquire new features, through which they appear to us as more highly developed forms. To the source of mistakes which arise from this unequal development of closely related types may be added the numerous errors which spring from the equal development in different groups.

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[1] Grundzüge der Palæontologie.

Of the different features which have to be considered in the classification of the Ammonites—the character of the sutures and their position relative to each other, the length of the body-chamber, the shape of the peristome, the sculpture, the epidermis—none by itself can be a safe guide in judging of the conditions of relationship of the various genera, although each feature may be of importance for the single genus. The determination of the genetic connection is the only guide to rely upon, and in this we have only succeeded in a very imperfect manner up to the present time, on account of the incompleteness, still very considerable, of the existing palæontological material. The knowledge of the great and important group of Ceratitoidea is in this respect the farthest advanced. We can trace it nearly in an unbroken succession from the Scythian series to the Rhætic stage. But even in this group of Ammonites there is still some room for further elucidation.

Where the genealogical tree of a family cannot be built up by direct observation, it will be useful to weigh all or several of the above-mentioned features one against the other carefully for the approximate judgment of the conditions of relationship and for putting the material together into groups and families. The sutures, which, within so large a series of related forms as are contained within the *Leiostraca* and *Trachyostraca*, show no remarkable deviations, are of importance for this grouping. Of the three modes of development of the sutures, the phylloid, the leptophyll and the dolichophyll, the first two are confined to the *Leiostraca*,[1] while the dolichophyll mode of development is characteristic of the *Trachyostraca*. The stages of development, which may be observed within these modes (*viz.*, lanceolate, monophyll, dimeroid in the phylloid sense of the term ; lanceolate, ceratitic, brachyphyll, leptophyll in the leptophyll plan of variation ; clydonitic, ceratitic, brachyphyll, dolichophyll in the dolichophyll mode of development) may occur in the same groups or families beside one another, as it is not necessary that the single diverging branches should develop in the same manner. There is the danger in the permian and triassic Ammonites, which are in the process of change from the goniatitic to the ammonitic stage, of attributing to such stages of development of the sutures a high degree of systematic significance not due to them, and I cannot help again pointing out this source of error. The conditions of relationship can generally only be ascertained by means of the morphological characters, the length of the body-chamber and the conditions of the sutures, but where it is possible, also by observing the ontogenetic stages. It is then shown, in many cases, that the shape and sculpture of the shells stand in a certain relation, not yet explained, to the arrangement of the sutures. I mention with reference to this, first the so-called Arietid forms,[1]—to which are also to be added the *Margarites*, *Distichites*, *Styrites* and *Tropiceltites*. It may further be pointed out that the occurrence of secondary lobes and saddles is always connected with a flat, disc-shaped, high-mouthed form of the shell. As the embryonic whorls of the Ammonoidea are always spherical and low-mouthed, it is to be supposed in this case that the addition of the secondary lobes and saddles, inserted from the external part, is caused only by the extremely quick growth of the height of the whorl. Even in the group of the *Trachyostraca* the division of the external saddle is occasionally shown in the quick increase of the height of the whorl, which reminds us of the secondary lobes and saddles of the *Leiostraca* (*Thetidites*, *Hauerites*, *Cyrtopleuri-ites*). Analogous cases could also be proved in jurassic Ammonites. These divisions of the external saddle are especially remarkable in the cretaceous genera *Sphenodiscus* and *Engonoceras*.

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[1] The phylloid and leptophyll modes of development are, in many cases, not so sharply divided as might be supposed by observing the typical forms of both modes. Not only may both be united in the same individual, as in *Pinacoceras*, where the secondary and the auxiliary saddles are of dimeroid form, and the principal saddles of leptophyll form, but the sutures of leptophyll mode of development not rarely show an inclination to dimeroid division of the saddles, as, for instance, many *Gymnites* and *Ptychites*.

The length of the body-chamber is also in a certain way related to the shape of the shell. High-mouthed shells generally possess a shorter body-chamber than shells with a low mouth. Young individuals have likewise a shorter body-chamber than adult specimens of mature age. Slight differences in the length of the body-chamber are also known within a single genus. I should like, therefore, to point out that too great an importance must not be attached to this feature, and that every little variation must not be made use of to establish a new genus. I would also oppose the other extreme which denies any systematic significance to the length of the body-chamber.

In my opinion the proper course is the middle one between these two extremes, and the length of the body-chamber carefully used is a very valuable classificatory feature.

While the sutures and the length of the body-chamber are of importance for the determination of more distant relationships, the conditions of sculpture play, with the constant help of the ontogenetic method, an important part in the establishment of the degrees of nearer relationships.

The difficulties of natural grouping are very great, as it is not a question of grouping according to superficial similarities, but of finding the natural affinities (genealogical trees) which can, of course, only be monophyletic. As the single genera must be monophyletic, the same claim must also be made for the grouping of genera into families and sub-orders. The natural family can only be considered to be monophyletic, and genera, whose nearer relationship and common origin appear to be excluded from one and the same type, must therefore not be united into one family.

1. HALORITES PROCYON, E. v. Mojs., Pl. I, Figs. 1—4 ; Pl. II, Figs. 1-2; Pl. III, Figs. 1-2.

This type is subject to many variations in size, form and suture-line. The outlines of the shell offer the most striking variations, so that a *varietas recta* and a *varietas obliqua* are to be distinguished. Within these two chief varieties there are still further distinctions to be observed in the dimensions of the full-grown adult individuals.

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[1] Cf. M. Neumayr, Zur Kenntniss der Fauna des untersten Lias. Abhandl. d. Geol. Reichsanst VII, Bd. 5, Heft 1, p. 45.

The *Varietas recta* is represented by Fig. 4, Pl. I, Fig. II, Pl. II, and Figs. 1-2, Pl. III, while the *Varietas obliqua* is shown in Figs. 1—3 on Pl. 1, and Fig. 1 on Pl. II.

In the *Varietas obliqua* the inner (chambered) whorls, as also the outer, modified whorl (body-chamber) of mature individuals are distinguished by a distinctly oblique-elliptical contour, which is produced by the retardation of the growth in height, occurring periodically at intervals of half a whorl.

The inner whorls cover one another almost entirely. They are wider than high (Fig. 1, on Pl. III, Fig. 3, on Pl. I.). The sides and the external part are inflated and not marked off from each other.

In the *Varietas obliqua* the external part appears to be less inflated in the region of the depression, as if it had been slightly compressed. The shell sinks down with a rounded umbilical margin into the very narrow umbilicus.

The strongly developed sculpture consists of wide, flatly rounded ribs, which are separated from one another only by narrow intercostal grooves and which continue without interruption over the sides and the external part in a tolerably straight radiating manner. Bifurcations of the ribs are to be observed at different heights. A primary division often occurs near the umbilical margin, and these primary, divided ribs, as also those chief ribs which do not undergo a bifurcation in the umbilical region, are often bifurcated on the sides for the second time, or for the first time. Some ribs, however, run across the sides without bifurcation, whereby tripartite bundles of ribs, instead of the more frequent quadripartite, arise. Further bifurcations appear then occasionally on the external edge, without having a corresponding bifurcation on the opposite half of the shell. The internal cast figured in Fig. 3, Pl. I, of *Var. obliqua* is distinguished by the constant appearance of such bifurcations of the ribs on the external part. There is, however, no correspondence of the ribs in this specimen, for even the chief ribs do not agree in their mode of division on both halves of the shell.

In the *Varietas recta* also the constant appearance of the bifurcation of the ribs on the external part was observed in one specimen—on the chambered part of the shell as well as at the beginning of the body-chamber.

Some specimens show in the last half whorl preceding the body-chamber, and also at the beginning of the body-chamber, in the middle of the external part, an indistinct, broad, longitudinal swelling, which does not however produce an interruption, but only an indistinctness of the transverse sculpture of the external part. But this median longitudinal line does not always keep exactly to the centre of the external part; for it shows, especially at the beginning of the last whorl, a slight inclination towards the left half of the shell.

The thickness of the ribs is subject to some variation; it appears to be generally the rule that those specimens which only reach their individual maturity after having attained considerable dimensions have coarser ribs than those which attain the stage of maturity when their dimensions are less. In the latter the ribs are less numerous and finer.

The last whorl or body-chamber of adults always takes a shape different from that of the inner whorls. A change of sculpture is always connected with these changes in the shape of the shell. As to the shape, a narrowing and a gradual individualisation of the external part takes place at the beginning of the last whorl, with which at the same time an accelerated increase of height begins in the *Var. recta*, while in the *Var. obliqua* there is a considerable reduction in the height of the first half of the last whorl; which increases again at the end of the first half of the whorl, but then more rapidly. It is in consequence of these features that *Var. obliqua* also shows on the side opposite the mouth a very strong inflation, which is distinguished from the inflation lying in the same position one whorl back by the strong narrowing of the external part. In the anterior half of the last whorl in the two varieties there is again a gradual widening and inflation of the external side, which appears to be in some individuals slightly flattened, in others slightly inflated, in the portion next to the region of the greatest compression.

The external part is thus always widely inflated near the mouth. The margin of the mouth itself is only partly preserved in the example of *Var. recta* given in Fig. 4, of Pl. 1. It bends, as it seems, along the whole circumference of that part of the tube lying external to the egression. There is a short convex lobe projecting anteriorly on the external side.

The umbilicus of the last whorl of the body-chamber is closed with a callus in the specimens having the shell preserved ; in casts, on the other hand (as is the case with all the figured specimens showing the umbilical region), it is open. The egression of the whorl, which is much less expanded when the shell is preserved than in the casts, occurs in the anterior half of the last whorl. The reason for this lies in the fact that a wide shell-band, running along the margin of the egression, is superposed directly upon the shell of the preceding whorl. The margin of the egression can therefore begin on the cast only outside this (then-broken-off) band.

The sculpture of the last whorl of the body-chamber shows a tendency to become flattened and gradually obsolete on the umbilical side and, on the other hand, gradually to thicken and form knobs on the external edge. On the posterior half of the last whorl the ribs begin to be more widely separated from one another, to flatten and to bend more or less in such a way that the concavity formed by the ribs, which now advance strongly towards the external part, seems to open towards the anterior end of the shell. In this region there are not seldom, with respect to the casts of the inner whorls, deviations in relation to the divisions of the ribs. Gradually the ribs become fainter on the sides of the shell, whilst they thicken towards the external edge. In the region of the greatest compression of the last whorl, at the mid-length of the body-chamber, there appear, simultaneously with the weakening of the sculpture of the sides, distinct marginal knobs, which in the anterior half of the last whorl again become somewhat fainter and approach nearer to one another. In this region there are often strong lines of growth on the shell at the external part. The knobs mostly disappear again immediately behind the margin of the aperture.

The length of the body-chamber comprises a complete whorl. The large specimen figured on Pl. II, fig. 2, shows some faint longitudinal lines on the sides of the cast of the body-chamber. Whether these lines have originated through injuries during the lifetime of the animal, as we assumed to be the case in some European species of *Halorites*, must be left undecided.

The normal-line was also observed on the cast of the body-chamber in the vicinity of the aperture.

The size of full-grown individuals is subject to some variation. The largest individual before me is a specimen belonging to *Var. recta* (Pl. II, fig. 2). The smallest, referred to the same variety, reaches a diameter of 56 mm.

Sutures.—The not inconsiderable individual variations which are shown in our illustrations of the sutures might lead to the supposition that there were here several species which could not be distinguished. Although we do not wish to exclude this probability we are inclined, nevertheless, to the opinion that we have only to deal with one species which is somewhat variable in the sutures. But above all, attention must be drawn to the feature, frequently observed in the Tibetan species of *Halorites*, *viz.*, that the later suture-lines of full-grown individuals become more and more simplified as they approach the last of them. The last septum, which then, as a rule, is only separated from the preceding septum by a very slight space, is distinguished by the short form of the saddles and the much less numerous and coarser denticulations of the lobes and saddles. Such a greatly simplified suture-line is represented by Fig. 1 d on Pl. I, whilst the suture line, Fig. 3c, of the same plate, provided with high, slender saddles, and graceful indentations, is taken from an internal cast. The suture-line, Fig. 4c of Pl. I, is the fourth counted from the last on the left half of the shell. It already approaches the simplified form of the last suture-line, which resembles very much the last represented in Fig. 1 d, but shows proportionally broader and lower saddles.

The dolichophyll-shaped suture-line generally bears completely the character and habit of the Juvavian species of *Halorites* of the European Mediterranean Province.

The deep external lobe is divided into two narrow, deep and one-pointed halves, by a high, laterally slightly serrated median projection of nearly rectangular outline. The points of the lobes either converge somewhat towards the median projection, or are parallel to it.

The two lateral lobes are, like the halves of the external lobe, one-pointed, and the first of them reaches beyond the depth of the external lobe. It is, therefore, the deepest of all the lobes. With the exception of about the last four suture-lines, immediately preceding the modified body-chamber, which, as mentioned above, always becomes shorter and more stumpy, the lateral lobes are distinguished by their narrow and deep points. Corresponding with these three principal lobes are three strongly developed, slender, dolichophyll, serrated saddles, of which the external one reaches the greatest height.

In sharp contrast to the principal lobes and saddles, the auxiliary lobes and saddles are only very poorly developed and may all be regarded, as in the large European species of *Halorites*, as a wide umbilical suture, bent upwards towards the umbilicus and divided into several small serrations (saddles). There may be from five to six of such serrations up to the umbilical suture.

Dimensions.—

	Internal cast.	*Adult form of Var. obliqua.*
Diameter	55 mm.	85 mm.
Height of the last whorl	27 „	28 „
Thickness „ „ „	39 „	40 „
Width of umbilicus	2 „	13[1] „

Locality and Geological position.—Juvavian stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 35.

2. Halorites sapphonis, E. v. Mojs., Pl. IV, Figs. 1-4.

The establishment and limitation of this species offers also in the present form, on account of its great individual variability, not inconsiderable difficulties, though they are fewer than in *Halorites procyon.*

The variations chiefly comprise the dimensions of mature individuals, and the conditions of the ornamentation as well as of the sutures.

The casts of the inner whorls, which are thicker than they are high and very narrowly umbilicated, possess a greatly developed ornamentation extending over the sides and the external part. This ornamentation differs from that of *Halorites procyon* in the bending of the ribs on the sides and in the constant appearance of bifurcations of the ribs on the external part of the shell.

As to the bending of the ribs on the sides, they form a concavity directed forwards, as may be seen on the cast figured on Pl. IV, Fig. 2. Bifurcations of the ribs occur on the sides at different heights, but mostly on the lower half, beside the umbilical margin. A two- to four-fold bifurcation of the ribs takes place on the margin of the external part, so that here occur bundles of narrow fine ribs instead of the broad ribs on the sides.

The external part is crossed in a straight line by the foremost bifurcated rib, whilst the second and third, following in similar bundles, have a convexity directed backwards. There is no exact correspondence between the bifurcated ribs on both sides of the shell. Some bifurcated ribs join with the more anteriorly or posteriorly lying principal rib; others again break as intercalated ribs on the opposite side, without being joined to a principal rib. The position at or before which the bifurcation of the ribs on the external part occurs, is distinguished in a number of specimens by a more or less distinct knotty swelling (Figs. 3, 4, Pl. IV). In some specimens there occur also occasionally close-set, fine, transverse ribs, which do not bifurcate on the external part nor show any knotty marginal swellings.

The last whorl of the body-chamber of adult individuals changes its shape in a similar manner to that in *Halorites procyon*, but the increase in height and the narrowing following from this on the external part are not so marked as in that species.

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[1] Egression of umbilicus.

The callus closing the umbilicus is followed by the curved line of the mouth-margin, which expands farther on casts than on specimens having the shell, for reasons explained in the description of *Halorites procyon.*

The sculpture of the last whorl of the body-chamber of adult individuals generally shows a tendency to thicken into marginal knobs on the external part, whilst the sculpture on the sides becomes weaker and almost entirely disappears on the anterior half of the surface in the region of the umbilicus.

The occurrence of irregular undulations of the ribs on the sides of the shell on the posterior part of the body-chamber whorl is very characteristic of *Halorites sapphonis.* The knot-like undulations are produced by the interference of normal transverse ribs, here very wide apart; these have faintly-indicated striated ribs (only visible in well-preserved specimens in an oblique light) running obliquely from the umbilicus across the sides, anteriorly towards the external part. Through the crossing of those two systems of ribbing there arises a kind of reticulation on the sides, which reminds us somewhat of the crossing of forward and backward running curves, met with in the beaded ornamentation of the European species of the catenate *Halorites*, but which is essentially differentiated therefrom by the direction of the cross ribs, which produces the reticulation.

In some specimens there arises on the second half of the penultimate whorl or only on the last whorl of the body-chamber, in the middle of the external part, a strong keel-like ridge (Fig. 4b, Pl. IV), accompanied by distinct longitudinal lines. This does not actually cause an interruption but only a slight weakening of the transverse sculpture passing over the external part. This ridge disappears again in the region of the marginal knobs. The latter, mostly well-developed, begin to appear, some of them earlier, some later, but in any case before the strongest compression and narrowing of the external part and reach almost to the mouth-margin, gradually getting wider apart and finally disappearing altogether.

In some specimens there is a flattening of the external part united with a weakening of the ribs thereon in the region of the marginal knobs; but in other individuals the external part remains slightly inflated. Specimens having the shell preserved show on the peripheral area between the marginal knobs well-developed lines of growth running in a straight direction.

The dimensions of the shell in mature individuals vary within the same limits as in *Halorites procyon.* The largest full grown form which is before me is represented in Fig. 1, on Pl. IV; the smallest mature form, preserved with the entire modified body-chamber whorl, attains a diameter of about 47 mm.

Sutures.—The presence of the feature already mentioned in connection with *Halorites procyon* may here also be established, *viz.*, that the last suture-lines of the adult individuals undergo a considerable reduction in the height of the saddles and their lateral branches, which are thus much more simple than the septa about a fourth of a whorl farther back. The isolated suture-line, Fig. 2c, of Pl. IV, is taken from the posterior half of the last whorl of the cast (Fig. 2a, 2b). The saddles are here much more slender and the lateral branches finer than in the last suture-lines immediately preceding the body-chamber. The last suture-line bordering the body-chamber in the specimen figured on Pl. IV, Fig. 4, is represented in Fig. 4c. In comparison with the suture-line, Fig. 2c, taken at about the same height of the whorl, the lobes appear shallower, the saddles considerably lower, and less finely formed.

The details of the suture-line agree in their fundamental features with those of the sutures of *Halorites procyon.* The three strongly developed principal saddles of which the external one reaches the greatest height are followed by an umbilical suture, which is divided into several (4-5) small auxiliary saddles, and bent upwards towards the umbilicus. The position of the sutures is normal.

Dimensions of an adult specimen. —

Diameter	75	mm.
Height of the last whorl	28	„
Thickness „ „ „	36	„
Width of aperture of umbilicus	14·5	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 17.

3. Halorites Charaxi, E. v. Mojs., Pl. III, Fig. 4.

Though at the first glance this form seems to possess a great similarity to *Halorites Alcaci,* a more minute examination shows that it is not allied to this species but rather to *Halorites procyon.*

It is especially the ornamentation of the inner casts, recognisable at the beginning of the body-chamber whorl, as well as the course of its ribbing, agreeing with *Halorites procyon*—in contrast to the irregular undulations of the ribs in *Halorites Alcaci*—which allows us to distinguish *Halorites Charaxi* without difficulty from *Halorites Alcaci.*

The inner whorls appear to possess approximately equal height and width. The sculpture consists of numerous flattened ribs, separated by very narrow intercostal furrows. The conditions of the bifurcation of these ribs seem to agree with those of *Halorites procyon.*

The body-chamber whorl, modifying its shape, is very considerably compressed in the middle third of its course, so that the sides become quite flat, whilst the external part is greatly narrowed and pointed.

After the commencement of the umbilical opening, which runs in the form of an arch and comprises about half of the last whorl—whether this is preceded by a callus closing the umbilicus could not be ascertained—the compression of the whorl reaches its culminating point, while towards the mouth there occur again a widening of the external part and a slight inflation of the sides which always lose in height in consequence of the umbilical opening. On a cast this opening seems to be considerably wider than in specimens having the shell preserved, on account of the well known circumstance that the shell is superposed closely upon that of the preceding whorl.

With regard to the modifications in the sculpture of the body-chamber whorl, the ribs become at the beginning of the latter broader and flatter, and the intercostal furrows considerably wider. On the external edge there appears gradually a knot-like thickening of the ribs which are but faintly indicated on the external part. The number of the marginal knobs is greater than in any other species known, which is attributable to the fact that there is in the region of the marginal knobs only a slight widening of the ribs, which increase in thickness in the marginal region and become knob-like. In the last half of the last whorl there occurs first on the sides but later also in the marginal region a complete obliteration of the sculpture.

Sutures.—Only the last three suture-lines are visible which are very near one another and evidently already greatly reduced in height. They appear to agree in general with the sutures of *Halorites procycn.*

Dimensions of an adult specimen.—

Diameter	62	mm.
Height of the last whorl	21·5	„
Thickness	20	„
Width of the umbilical opening (on the cast) about	13	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

4.—Halorites phaonis, E. v. Mojs., Pl. III, Fig. 5; Pl. V, fig. 1.

I regard the form with the edge of the aperture preserved figured on Pl. V, as the type of the present species, which is closely related to *Halorites procyon.*

Halorites phaonis is distinguished from *Halorites procyon* chiefly by its much more slender and more compressed form and by the closer and finer ribbing of the inner whorls.

The bifurcation of the ribs, as well as the variations of the sculpture occurring on the body-chamber whorl, agree with the same features as are met with in *Halorites procyon.* The external part remains inflated in the region of the marginal knobs. The sculpture crossing over the narrow external part shows broad ribs whose convexity is directed posteriorly; these ribs are greatly weakened in the median region. On the anterior part of the body-chamber whorl indications of the marginal knobs remain visible, it is true, up to the region of the apertural margin, but there occurs also in this species a considerable weakening of the sculpture, which coincides with the increase of the inflation of the external part and of its widening.

The edge of the mouth is bent up in a trumpet-like manner on the cast.

The umbilical opening comprising about half the last whorl is, to all appearance, preceded by a callus closing the umbilical depression.

The incomplete specimen, figured on Pl. III, Fig. 5, is distinguished from the typical form by more finely ribbed inner whorls, by the appearance of spiral lines on the compressed part of the body-chamber whorl and the deviations of the widely separated fold-like ribs caused by these lines. The external part of this specimen is somewhat more flattened in the region of the marginal knobs on the last whorl. The ribbing is almost entirely obliterated by a median smooth band.

Sutures.—In the last suture-lines preceding the body-chamber there occurs a simplification similar to that which occurs in *Halorites procyon.* The suture-line given on Pl. III is the penultimate one, whilst the fifth from the last is represented on Pl. V.

With reference to the details of the suture-lines there is no essential difference to be observed in comparison with the species occurring in the same horizon, unless it be that the number of the serrations in the little saddles forming the umbilical suture is somewhat less.

Dimensions of an adult specimen.—

Diameter	75	mm.
Height of the last whorl	26	„
Thickness	30	„
Width of the umbilical opening	13	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

5. Halorites Alcaci, E. v. Mojs., Pl. III, Fig. 3.

This species is to be regarded as a form closely related to *Halorites sapphonis,* both by the nature of the sculpture of the casts of the inner whorls and the irregular bending of the fold-like ribs at the beginning of the last whorl.

The cast of the inner chambers is somewhat more compressed, but nevertheless thicker than high. The flattened, fold-like ribs are much more numerous and narrower than in the species with which this is compared; they seldom have bifurcations near the umbilicus but more frequently on the sides and on the external part (cf. Fig. 3c), and on the latter in such a manner that the bifurcated rib either closes again on the other half of the shell or runs on bifurcated. In the latter case, therefore, one rib of one half of the shell corresponds with two ribs of the opposite half. The ribs run nearly straight on the sides, or with manifold bifurcations more strongly bent outwardly, so that a concavity arises which opens anteriorly.

The body-chamber whorl of adult forms is distinguished by a very distinct, widely expanding, arch-shaped opening appearing after the callus which closes the umbilical depression, as well as by the great number of closely set marginal knobs. On the posterior part of the last whorl, where the compression has already begun, the widely separated ribs are to be seen; they are irregularly branched and provided with faint knotty swellings similar to those of *Halorites sapphonis,* but without any cross ribbing being perceptible.

Towards the margin of the aperture which sends forth a projecting external lobe the external part is widened and inflated, the marginal knobs disappearing entirely.

On the median line of the external part one observes two fine longitudinal grooves on the cast of the body-chamber whorl; these enclose a median thread-like band (Fig. 3b). On the anterior part of the last whorl this band, corresponding to the so-called normal line, disappears.

Sutures.—Not known.

Dimensions.—

Diameter	52 mm.
Height of the last whorl	17 „
Thickness „ „ „ „	22 „
Width of the umbilical opening	12·5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

2. JOVITES, E. v. Mojs., cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 13.

1. JOVITES, n. f. ex aff. J. bosnensis, Pl. IX., Figs. 4, 5.

The two figured fragments belong to mature specimens whose body-chamber whorl not only shows the very distinct umbilical opening, but also parts of the whorl in the vicinity of the mouth-margin.

The two fragments differ from one another with reference to the cross section of the anterior part of the last whorl, as well as with reference to the height of this anterior part, but I am of opinion that these differences are only individual and perhaps caused by the somewhat different dimensions.

The general form, the sculpture on the casts of the inner whorls and the umbilical opening of the body-chamber whorl agree essentially with *Jovites bosnensis* (E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, II. Bd, p. 52, Taf. LXXXIII, Figs. 2-3, Taf. CXCVI, Fig. 6), and only the sculpture of the body-chamber on the umbilical margin proves that we have to deal here with a species different from *Jovites bosnensis.* Whilst, namely, in *Jovites bosnensis,* as well as in *Jovites dacus,* the sculpture changes into broad, flat, undivided folds on the umbilical margin of the body-chamber whorl, the character of the ribs and their bifurcations remain in the present species the same as they were in the earlier parts of the shell. Another feature which distinguishes the present species from *Jovites bosnensis* is the persistence of the faint keel-like projection in the middle of the external part extending to the end of the last whorl.

Sutures.—Not known in detail. The suture-line, simplified by weathering, shows the remarkable contrast between the two principal saddles and the auxiliary saddles, so greatly reduced in height, a contrast characteristic of *Jovites.*

Dimensions.—

Diameter	70 mm.
Height of the last whorl	25 „
Thickness	34 „
Width of the umbilicus	20 „

Locality and Geological Position.—In the red Limestone with crinoids of Kiogarh Range, south of Sangcha Talla. Number of specimens examined, 4. Also some specimens from the Tropites-Limestone of Kalapani appear to belong to the present species.

2. Jovites cf. dacus, E. v. Mojs., cf. *Jovites dacus*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 49, Taf. LXXXIV, Figs. 1—8.

An internal cast, elongated and distorted, from the Tropites-Limestone of Kalapani lies before me, which in shape and sculpture agrees well with the casts figured on the above-cited Plate, as Fig. 6. But as neither body-chamber nor sutures are known it must remain undecided whether there exists a specific agreement with *Jovites dacus*, or whether we have here only a very closely related representative species.

3. Jovites, ind. ex aff. J. daci.

A partly silicified internal cast of 44 mm. in diameter agrees in outer form with the internal casts of *Jovites dacus*, but is distinguished from these by the somewhat coarser sculpture and also by the more complicated sutures.

The sculpture, which has the same direction as in *Jovites dacus*, consists of much broader, flat, fold-like, transverse ribs, which seem to be somewhat interrupted on the external part by the median keel-like projection, in which the horny well-preserved siphuncle lies. Such an interruption does not take place in *Jovites dacus* but also here perhaps the somewhat defective preservation may have caused the appearance of one.

The suture line shows, especially on the pretty well recognisable external saddle, a considerably richer dolichophyll branching, which reminds us of the degree and manner of bifurcation of the more highly developed typical species of the genus *Halorites*. We may refer for comparison to the sutures of *Halorites Alexandri* of the middle Juvavian beds of Europe (Cephalopoden der Hallstätter Kalke, II Bd., Taf. LXXIV, Fig. 2c).

The present species, like *Jovites dacus*, possesses only one lateral lobe, for the projection of the preceding whorl coincides with the first lateral saddle.

Locality and Geological Position.—From layer No. 2 of the Daonella beds of Rimkin Paiar. Number of specimens examined, 1.

3. Parajuvavites, E. v. Mojs.

This group of forms, rather rich in species, agree in sculpture with the European species of *Juvavites* of the group of *Interrupti*, and are distinguished from *Juvavites*, in which genus a narrowing of the umbilicus occurs in the mature stage, by the opening of the umbilicus, which begins on the last whorl before the aperture. *Parajuvavites* takes a kind of morphologically intermediate position between

Halorites and *Juvavites* on account of this feature; but it must be here specially emphasized that a genetic link can in no way be formed by it between the genera just mentioned.

Parajuvavites stands very near to the genus *Halorites* through its sutures, especially through the development of three principal saddles, which are mostly followed by only slightly developed auxiliary saddles and are as disconnected as those of *Halorites*. The less markedly dolichophyll bifurcation might partly at least be accounted for by the smaller dimensions of the specimens used in the investigation. The lobes are throughout one-pointed, as in *Halorites*, but it is seldom that the middle point reaches the same depth as in the latter genus. But there is also a great similarity with the lobes of the typical species of *Juvavites*. As a distinction it can only be mentioned that in *Juvavites* whenever auxiliary saddles appear they are better developed and proportioned.

Parajuvavites may be established as one of the most characteristic genera of the lower Juvavian sedimentary rocks of the Indian trias Province and occurs as well in the horizon below the Halorites-Limestone as in the Halorites-Limestone itself.

Of all the forms which are known in Europe the isolated lower Juvavian *Jovites mercedis* (Cephd. d. Hallst. Kalke, II. Bd., p. 55, Taf. LXXXV, Figs. 1-5) shows the greatest similarity with *Parajuvavites*, without being related to any of the Indian species. Supposing this species belonged to *Parajuvavites*, it would indicate a group of *Continui* with an uninterrupted transverse sculpture on the external part, while the Indian species would form a group of *Interrupti*. After separating *P. mercedis* from the genus *Jovites*, the latter, which possesses two large saddles in the typical representatives—in contrast to the three large saddles of *Halorites* and *Parajuvavites*—seems to be much better defined as a genus.

1. PARAJUVAVITES BLANFORDI, E. v. Mojs., Pl. V, Fig. 2; Pl. VIII, Figs. 6, 7.

This species is represented by two varieties. The one, which is characterised by its obliquely elliptical outline, may be distinguished as *Var. obliqua*. It is given in Fig. 2 on Plate V. The second variety—*Var. recta*—has the normal form. It is shown in Figs. 6 and 7 on Plate VIII.

The inner whorls, almost overlapping one another, and being very narrowly umbilicated, are considerably thicker than they are high and provided with a broadly inflated external part. In *Var. obliqua* there are at distances of half a whorl apart inflations caused by a greater increase of height and between which there are regions in which the whorl is reduced in height.

Full-grown individuals possess a widening body-chamber whorl on which the sides become considerably flattened; this is connected with gradual compression. While on the inner whorls, corresponding with their considerable thickness, there is a rather high umbilical wall, there is an extremely low one on the widening whorl with flattened sides. There is again a slight inflation towards the aperture and a widening of the external part. There is only a portion on each side of the mouth-margin preserved in the form, Fig. 6 on Pl. VIII. The invagination of the margin is distinctly seen. The small specimen figured (Fig. 7, Pl. VIII) is by no means, as one might suppose, only an internal cast. It possesses, on the contrary, as it seems, the whole of the last whorl, the body-chamber and may therefore, as it agrees otherwise completely with the internal casts of *Parajuvavites Blanfordi*, be regarded as a specimen with body-chamber which is not yet full-grown and therefore not yet provided with a widening body-chamber whorl.

The sculpture consists of strong ribs, separated by broad intercostal furrows and bifurcated beyond the middle of the sides of the shell. These ribs, tending as they do to go in an almost straight direction, do not altogether do so but somewhat incline towards the anterior part, running from the umbilicus across the sides to the external part, where they undergo an interruption in the middle region made by a smooth band. Three-fold bifurcations of the ribs occur isolated also on the inner whorls, and the place where they bifurcate lies somewhat lower on the body-chamber of mature individuals.

The specimen of *Var. recta* shown in Fig. 6 on Pl. VIII. is remarkable on account of the occurrence of a fine longitudinal line visible at the beginning of the last whorl, which is similar to the normal lines on the cast of the external part. The form (Fig. 2, Pl. V) attributed to *Var. obliqua* shows knob-like swellings at the extremities of the marginal ribs in the narrowed region of the body-chamber whorl. This feature reminds us of the marginal knobs of *Halorites*. The above-mentioned specimen is further distinguished from the other forms before me of both varieties by the fact that the ribs on the body-chamber whorl are wider apart from one another.

The length of the body-chamber comprises more than a whole volution.

Sutures.—In a similar manner to the Indian species of *Halorites* it is also here shown that in mature individuals the suture-lines seem to be very close together and the height of the saddles compared with the preceding suture-lines seems to be shortened. This feature can be distinctly traced in the figured cast (Fig. 2, Pl. V) on the external saddles, as the penultimate whorl is freed through the breaking off of part of the last whorl.

The dolichophyll suture-line is distinguished by the rapid decrease in the height of saddles in the direction from the external saddle to the auxiliary ones. The steep inclination of the external saddle seems to be remarkable compared with the deep external lobe, which is divided by a high median projection. The second lateral saddle is directed on the inner side towards the umbilicus, badly individualised and only indistinctly separated from the two or three following small auxiliary saddles.

Dimensions of an adult specimen.—

	Var. recta cast.
Diameter	69 mm.
Height of the last whorl	28 „
Thickness	29 „
Width of the umbilical opening	10 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 4.

2. Parajuvavites Laukanus, E. v. Mojs., Pl. V, Fig. 3.

The globose figured shell is an adult individual with the apertural margin preserved.

At the beginning of the last whorl the sides and external part are much inflated. Later there occurs a narrowing of the external part, together with a flattening of the sides, followed towards the end of the last whorl by a depression, which is connected again with the somewhat increasing inflation of the sides as well as with a broadening of the external part. The umbilical opening is not considerable though it comprises about half a volution.

The aperture of the mouth is contracted by the invagination of the margin of the shell.

The sculpture shows strong ribs bordered by deeply cut intercostal furrows, the ribs forming a slight concavity which opens anteriorly on the sides, and a slight convexity towards the anterior on the external part. In the median line of the external part the ribs are partially interrupted on the body-chamber cast by a smooth band, whilst at the beginning of the last whorl the shell does not show such an interruption, but the ribs are continuous on the external part. The above-mentioned band on the external part is bordered on both sides by a thread-like line—the normal line.

With reference to the divisions of the ribs on the sides the simple forked division at half the height of the sides is the rule. Owing to the circumstance that two neighbouring chief ribs occasionally unite in the vicinity of the umbilicus there arise four-fold divided bundles of ribs. Three-fold divided bundles are seldom observed.

Sutures.—Not known.

Dimensions.—

Diameter	50 mm.
Height of the last whorl	27 „
Thickness	30 „
Width of the umbilical opening	5 „

Locality and Geological Position.—Juvavian Stage; found in débris near Lauka, *e.g.*, probably in the Halorites-Limestone. Number of specimens examined, 1.

3. Parajuvavites Sternbergi, E. v. Mojs., Pl. V, Fig. 4.

The figured specimen which may stand as the type of the species, possesses an obliquely elliptical outline, which is caused by the depressions at the beginning of the last whorl and at the beginning of the anterior half of it. But we can recognise no specific character in this feature, judging by the experience gained in the case of

Halorites procyon and of *Parajuvavites Blanfordi.* We are therefore inclined to assign two fragments to *Parajuvavites Sternbergi,* as they agree in shape and sculpture with the type species, from which however they are distinguished by their normal form.

The narrowly umbilicated shell consists of widely embracing whorls, which are also higher than broad where they are still chambered. On the anterior half of the body-chamber whorl there is a distinct compression, connected with a corresponding narrowing of the external part. Extremely insignificant and scarcely noticeable is the opening egression of umbilicus. On the other hand the figured specimen, which is the only one well preserved, shows a distinct inflexion, or it may be described as a very sharp bend on the external side, near the aperture. It has almost the appearance as if here an individual, or perhaps a pathological abnormality existed, for on this apparently compressed part irregularly running lines of growth are observable on the cast. The margin of the aperture itself is not preserved.

The sculpture at the beginning of the last whorl is rather crowded. The numerous, distinctly formed transverse ribs are separated from one another by intercostal furrows which are as broad as the ribs. On the body-chamber whorl the ribs, as well as the intercostal furrows, increase very rapidly in width, so that a considerable contrast in the strength of the ribbing is shown on the last whorl.

The divisions of the ribs occur at varying heights on the sides, sometimes in the vicinity of the umbilicus, sometimes in the middle of the sides and sometimes beyond it. The bundles of ribs arising out of these divisions are mostly four-fold. More rarely the ribs are only singly divided; in these the bifurcation always takes place only beyond the middle of the sides. The ribs run nearly straight and only show a slight bend whose concavity is directed anteriorly. The transverse sculpture is slightly interrupted in the middle line of the external part. The two halves of the shell do not exactly correspond in their sculpture, the ribs occurring alternately in the middle line. At the beginning of the last whorl, on the external part, the cast shows to the left of the median smooth band a continuous longitudinal line, and to the right knob-like swellings of the ribs which evidently correspond with the longitudinal line on the other side. Also on the margin of the external part here flattened knob-like swellings of the ribs are noticeable.

On the anterior part of the last whorl the smooth area of the external part widens and occupies the whole width of the greatly narrowed external part, immediately behind the contracted part of the shell near the aperture.

Sutures.—Similar to those of the other species of *Parajuvavites.*

Dimensions.—

	In the line of contraction.
Diameter	54 mm.
Height of the last whorl	28 „
Thickness	16 „
Width of the umbilicus	3·3 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

4. PARAJUVAVITES FEISTMANTELI, GRIESBACH, Pl. VII, Figs. 1—3.

1880. Tropites Ehrlichi, var. *Feistmanteli*, Griesb., Palæontological Notes on the Lower Trias of the Himálayas. Records, Geol. Surv. of India, Vol. XIII., Pt. 2, p. 98.

1891. Tropites Ehrlichi, var. *Feistmanteli*, Griesb., Geology of the Central Himálayas. Mem. Geol. Survey of India, Vol. XXIII, p. 142.

1892. Halorites, ind., E. v. Mojs., Vorläufige Bermerkungen über die Cephalopoden-Faunen der Himalaya Trias. Sitzungsber. kais. Akad. d. Wiss., Bd. CI., p. 3.

The originals of Griesbach's species are two somewhat weathered, loose, internal casts from Rimkin Paiar[1] which very probably belong to the same species as the specimens lying before me from Bambanag, but this is by no means beyond doubt. It might in fact be a question whether the species distinguished here as *Parajuvavites Jacquini* is not identical with Griesbach's originals. As a correct decision as to the close relationship of the two forms is impossible, I will, in order to retain the name of Griesbach's species, make use of it for the present one. The somewhat more slender shape and the finer ribbing of Griesbach's casts, in comparison with those of *Parajuvavites Jacquini*, induce me specially to do this.

The inner casts only possess a narrow umbilicus in consequence of the deep embracing of the whorls. The external part is inflated and connected by a swelling with the sides which ascend towards the umbilical margin.[2] The whorls are somewhat higher than broad. The transverse sculpture upon the middle of the external part is, in consequence of the incomplete correspondence of the two halves of the shell, interrupted by a band-like area. It consists of fold-like rounded ribs, separated by narrow intercostal furrows, which in their course across the whorl turn from the umbilicus only a little towards the anterior. Divisions of the ribs occur on the sides at half of their height or beyond, and bundles of ribs arranged in a three-fold manner are prevalent. Some of the chief ribs running from the umbilicus are distinguished by greater strength, especially on the lower half of the sides.

The body-chamber whorl of full grown specimens is distinguished by a rather considerable compression of the whorl occurring before the commencement of the widening of the umbilicus. This compression reaches the end of the posterior half of the whorl. Coinciding with the umbilical opening, which extends over half of the last whorl, there again occurs a slight depression of the whorl which reaches its culminating point with the slight inflexion of the external part appearing at the aperture. The height of the umbilical wall decreases slightly as the umbilicus widens.

With reference to the sculpture of the body-chamber whorl: two-fold ribs as well as three-fold ones are seen on the posterior half of it, whilst almost exclusively two-fold ribs occur on the anterior half.

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[1] I had placed these casts in the above-cited communication in *Halorites* without having any knowledge of the last whorl.

[2] In the front view, Fig. 2*b*., the umbilical margin has been wrongly represented as turned upwards. The cause of this erroneous representation arose from the circumstance that on the anterior broken edge part of the area of the sides was broken off, whereby the umbilical margin appeared to jut out.

Near the aperture the ribs unite over the external part. Here they are also narrower and stand closer together.

Parajuvavites Feistmanteli is, as above mentioned, very closely related to *Parajuvavites Jacquini*. As distinguishing features, besides the dimensions, there may be mentioned the flatter shape of *Parajuvavites Feistmanteli*, the not inconsiderable compression of the last whorl and the appearance of three-fold ribs on its posterior half.

Sutures.—The indistinctly dolichophyll suture-line reaches its greatest depth in the first lateral lobe, which, like the two halves of the external lobe and the other lobes is one-pointed. The greatest height is reached by the slender external saddle, which is followed by the other saddles, decreasing rapidly in height. Of auxiliary lobes there are three to four beyond the umbilical margin. The first of them has the least depth, whilst those following towards the umbilicus increase in depth. The slight depth of the group of auxiliary lobes is remarkable when compared with the lateral lobes.

Dimensions.—

Diameter	72 mm.
Height of the last whorl	30 „
Thickness	27 „
Width of the umbilicus	11 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 6; and in the same horizon near Rimkin Paiar, 2.

5. Parajuvavites Jacquini, E. v. Mojs., Pl. VI, Figs. 4—7; Pl. VII, Figs. 1-2.

The individual variations to which this species in respect to its size as well as its ribbing is subject are not unimportant. There are, however, transitional forms between the extreme individuals which are figured here, so that there can be no doubt that they are specifically identical.

The species is closely related to *Parajuvavites Feistmanteli* and the internal casts of *Parajuvavites Jacquini* are only to be distinguished from the casts of *Parajuvavites Feistmanteli* by their somewhat coarser ribbing and their mostly somewhat thicker shape. Although the external part is as a rule rounded, it is in some specimens, as in the cast figured on Plate VII, somewhat flattened.

But a correct distinction between the two closely related species is only possible in specimens which are full grown and provided with a body-chamber whorl. While *Parajuvavites Feistmanteli* shows, in consequence of the considerable compression in the region of the aperture, an obliquely elliptic outline of the body-chamber whorl, the compression in *Parajuvavites Jacquini*, connected with no extraordinary increase of height, occurs somewhat later, almost coinciding with the umbilical opening, and the outline of the whole shell is not remarkably influenced by the compression which is principally confined to the narrowing of the external part. At the aperture there is an inflexion of the shell which is strongest on the external part and through which the lumen of the tube suffers no inconsiderable contraction (Fig. 4, Pl. VI).

While the inner whorls show no variations worth mentioning in the strength and proximity of the ribbing, very important individual deviations occur on the body-chamber whorl. In figure 4, Pl. VI, the form with the most close-set ribs is represented. At the beginning of the last whorl this specimen still shows three three-fold divided ribs—this three-fold division is the rule in the inner whorls—which are then followed by singly forked ribs. Towards the aperture the ribs are closer together and become finer and three-fold ribs occur here and there, but these always follow undivided single ribs.

The specimen, namely, Fig. 5 of the same plate, possesses broader ribs separated by wide intercostal furrows on the body-chamber whorl. These ribs are only at the beginning of the whorl twice trifurcate, but otherwise, with a single exception, only bifurcate. Towards the aperture the position of the bifurcation of the ribs is more and more outwards.

In specimen, *viz.*, Fig. 6 of the same plate, there are only forked ribs, separated by very wide intercostal furrows and therefore far apart from one another. Also in this specimen, distinguished by its small size, the position of the division of the ribs is more and more outwards towards the aperture.

In the similarly small specimen, Fig. 7 of the same plate, the ribs are on the greater part of the last whorl wide apart and separated from one another by broad intercostal furrows. Only towards the aperture, where the external part widens again, the ribs become more numerous and are thus necessarily closer together. There are no tripartite ribs in the whole circumference of the last whorl, but single undivided ribs are here and there to be observed. The predominant kind of rib-division is the bipartite one. The part near the umbilical opening seems smooth on the cast, so that the ribs only begin beyond this smooth area.

In Figure 1 of Plate VII a complete specimen is represented, which is equal in size to the last specimen spoken of (Fig. 7, Plate VI), but is distinguished from it by much more numerous and closer-set ribs. Tripartite ribs are found especially on the posterior part of the last whorl, but also here and there in the anterior regions. The bipartite rib is here also the predominant one. The area surrounding the umbilical opening is smooth on the cast. In the median region of the external part the sculpture is interrupted by a smooth area where the ribs die out. Only in the foremost part of the body-chamber whorl the sculpture covers the external part more or less completely.

Sutures.—With respect to the suture-line, the feature mentioned under several species of the closely related genus *Halorites*, *viz.*, the simplification of the last closely set suture-lines, must also here be stated to exist. Internal casts show more complicated sutures with high slender saddles and deep lobes, whilst the last sutures are distinguished by the widening and lowering of the saddles, associated with more simple indentations.

Contrasted with *Parajuvavites Feistmanteli* important differences in the course of the suture-line are scarcely to be established, except that the lateral lobes in *Parajuvavites Jacquini* appear nearly two-pointed and that beyond the umbilical margin there are in *Parajuvavites Feistmanteli* four, in *Parajuvavites Jacquini*, on the other hand, only two auxiliary lobes.

Dimensions.—

Diameter	60	mm.
Height of the last whorl	25	„
Thickness „ „ „	24	„
Width of the umbilicus	8	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 24.

6. PARAJUVAVITES TYNDALLI, E. v. Mojs., Pl. VII, Figs. 3, 4.

Like *Parajuvavites Feistmanteli* and *Parajuvavites buddhaicus* the present species is also distinguished by an obliquely elliptical outline of the body-chamber whorl. But while in the above-named two species the position of the strongest compression, respectively, of the expansion caused by it, is just half a whorl behind the aperture, a depression lies in *Parajuvavites Tyndalli* half a whorl behind the aperture and the strongest expansion is only a fourth of a whorl behind the aperture. *Parajuvavites Tyndalli* shares with *Parajuvavites buddhaicus* alternating regions of depression and compression, and both are distinguished by this feature, which appears on the second half of the penultimate whorl, from *Parajuvavites Feistmanteli*, in which only a single expansion occurs on the last whorl.

In the last expansion connected with a very considerable compression the previously widely arched external part narrows in *Parajuvavites Tyndalli* into an obtuse narrow arch and increases in width again towards the depressed aperture. This strong pointing of the external part is not visible in our front view, Fig. 3b, for the reason that it only occurs in the anterior half of the last whorl. The present species also has the same circumference at the umbilical opening as *Parajuvavites buddhaicus*.

With reference to the character of the sculpture there exists a greater similarity however, to *Parojuvavites Feistmanteli*. The rather strong ribs are on the inner whorls mostly tripartite, but on the body-chamber whorl partly bipartite, partly tripartite and here and there even also quadripartite. In two forms to which the figured one belongs, the ribs are compressed together fold-like; in two other specimens, on the other hand, they are smaller and raised. On the external part the sculpture is interrupted by a smooth band.

Sutures.—The sutures shown in the illustration form the penultimate of the strongly interlocking last suture-lines, probably considerably reduced in height. To all appearance the suture-lines lying farther back might have much slenderer higher saddles and agree with the sutures of related species in essential points. Beyond the umbilical margin there are three small auxiliary lobes. The first lateral lobe ends in a deep point. Its double point is an error of the draughtsman, who drew the point at the side of the external saddle down to the middle of the lobe.

Dimensions.—

Diameter	60 mm.
Height of the last whorl about	26 „
Thickness of the last whorl	20 „
Width of the umbilicus about	7 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 4.

7. PARAJUVAVITES RENARDI, E. v. Mojs., Pl. VII, Fig. 5.

This slender form seems to be most closely related to *Parajuvavites buddhaicus* from which, apart from its much smaller size, it is specially distinguished by its regular outline and by the fact that the external part is never pointed.

At the beginning of the last whorl the small shell possesses a narrow, slightly flattened external part and flat slightly inflated sides, which after the commencement of the umbilical opening become still flatter, increasing at the same time in height. The external part widens again towards the aperture without becoming flatter. Though the umbilical opening does not expand widely, it comprises however more than half of the last whorl.

The sculpture consists at the beginning of the last whorl of closely-set fine ribs which fork at various heights and are strong and rounded at their upper end. These ribs are mostly arranged in bundles of four or five. Ribs which are only once forked are rare. The sculpture is interrupted on the external part and shows a thread-like longitudinal line at the beginning of the last whorl which soon disappears again and which does not exactly keep to the middle of the external part but inclines somewhat towards the left.

With the beginning of the umbilical opening, especially on the sides, the ribs become broader and more fold-like, the intercostal furrows increase in breadth and the forked ribs are not distinctly joined to the strong chief ribs but run into the broad intercostal furrows of the chief ribs, without any strongly marked boundary. On the anterior part of the last whorl, where the external part widens again, the ribs, which have been interrupted up to this on the external part, close completely, forming a short arched external lobe in such a manner that the ribs which have again become much stronger and very distinctly marked on the sides reach their greatest strength in the middle of the external part. This therefore evidently shows a tendency of the ribs to close together and to become stronger at the termination of the body-chamber whorl. At the aperture the shell bends slightly over towards the lumen of the tube.

Sutures.—Not known.

Dimensions.—

Diameter	43 mm.
Height of the last whorl	19 „
Thickness „ „ „	18 „
Width of the umbilicus	5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

8. PARAJUVAVITES LUDOLFI, E. v. Mojs., Pl. VII, Figs. 7-9.

That these specimens belong to a species which is distinguished by an extraordinarily small umbilical opening and are not to be regarded as incomplete examples of a form with a wider umbilical opening, is especially proved by the form, Fig. 8, which is provided with a contracted aperture. But that also the two other specimens, in which, it is true, the aperture is wanting, are almost completely full grown individuals, is seen in the closing together of the ribs in the sculpture of the external part, which in *Parajuvavites* begins as a rule, only in the last part of the last whorl in mature individuals. The two specimens, namely, Figs. 7 and 8, represent a somewhat smaller flatter variety, with flatter external part, whilst the form, Fig. 9, belongs to a larger, thicker variety whose external part is more rounded.

The beginning of the opening, which comprises the anterior half of the last whorl, but is only associated with a comparatively slight widening of the umbilicus, is remarkable on the sides for its compression and on the external part for its narrowing. As a rule there is a widening towards the aperture again of the external part caused by the depression which exists there.

With reference to the sculpture, which consists of strong broad ribs with wide intercostal furrows, the form represented in Fig. 7 is distinguished by the strong bending of the ribs on the sides. The bipartite rib is the predominant one. Through the joining of the stems of two neighbouring forked ribs there arise bundles of quadripartite ribs. Tripartite ribs are seldom observed. The large specimen, Fig. 9, shows more faintly developed and more fold-like ribs in the compressed region of the sides.

On the external part of the inner whorls and on the greater part of the body-chamber whorl the sculpture is interrupted, a condition which is connected with the alternate appearance of the ribs coming from both sides. Only in the last fourth of the last whorl the above-mentioned closing of the ribs takes place, which is at the same time associated with their strengthening.

Sutures.—The simple form of the sutures, which keep the middle course between brachyphyll and dolichophyll development, might be traced to the fact that the sutures, represented in Fig. 7, are the last which immediately precede the body-chamber. The type of suture is the same as in the other species of *Parajuvavites*. There are two small auxiliary lobes outside the umbilical margin. The two halves of the external lobe, as well as the lateral auxiliary lobes, are one-pointed.[1]

Dimensions.—

Diameter	43 mm.
Height of the last whorl	20 „
Thickness „ „ „	14 ,
Width of the umbilicus	4 „

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[1] That the lateral lobe has two points in our illustration is due to an error on the part of the draughtsman.

Locality and Geological Position.—Juvavian Stage; of Halorites-Limestone of the Bambanag Section. Number of specimens examined, 4.

9. PARAJUVAVITES MINOR, E. v. Mojs., Pl. VII, Fig. 6.

This form is closely allied to *Parajuvavites Ludolfi*, and is perhaps only a variety of that species. But as no transitional forms are known, and not only its smaller size but also the finer and much more closely set sculpture may be taken as distinguishing features, it seems to me advisable to regard *Parajuvavites minor* as an independent form.

The slightly compressed shell, provided with a rounded, not very wide external part, possesses an umbilicus which is proportionally wide and only has a very small umbilical opening on the anterior part of the body-chamber whorl. The stronger compression of the whorl which occurs in other species is here scarcely indicated by reason of the small umbilical opening. Towards the aperture, however, there is a slight depression of the whorl especially noticeable on the flattened portion of the external part. The margin of the aperture is not preserved; but from some fragmentary remains it is to be seen that the tube has also in the present species undergone a narrowing through the inflexion of the aperture.

The bundles of ribs arising through their division comprise furcations 2 to 5 in number. In the bundles, which are more than tripartite, the first furcation occurs in the vicinity of the umbilical margin. The other furcations are beyond the middle of the sides. On the inflected part of the aperture the ribs are distinguished by greater fineness and a more crowded condition. On the external part the sculpture with alternating ribs coming from both halves of the shell is slightly interrupted in the median line, and the tendency of the ribs to continuously cross the external part is only exhibited in the region of the aperture. Interrupted ribs are also here predominant, associated with uninterrupted ones which irregularly alternate with the former.

Sutures.—Not known in detail.

Dimensions.—

Diameter	34	mm.
Height of the last whorl	17	„
Breadth „ „ „	12	„
Width of the umbilicus	4	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

10. PARAJUVAVITES BRINTONI, E. v. Mojs., Pl. X, Fig. 8.

By its dimensions and the strength of its sculpture this species shows the greatest resemblance to *Parajuvavites minor*, from which it is, however, distinguished by the greater expansion of the umbilical opening and the greater width of the umbilicus caused by this, as well as by the alternating appearance of strongly developed principal ribs.

The small shell possesses slightly flattened sides and a flattened external part, separated from the sides by rounded margins. The umbilicus is already proportionally wide before the beginning of the umbilical opening which comprises more than the anterior half of the body-chamber whorl.

The sculpture shows striæ-like folds, which, however, vary somewhat through the occurrence of isolated, strongly swollen ribs. These stronger chief ribs are specially shown in the posterior half of the last whorl, but also here and there on the extreme anterior part of this whorl. The paired division of the ribs is also in this form the predominant one but tripartite ribs also occur. Two neighbouring stem ribs sometimes unite on the lower half of the sides, whereby bundles of four to five divisions arise.

The intercostal furrows increase in width towards the aperture, so that the ribs are now wide apart from one another. Lines of growth running parallel with the ribs occur also in this region.

On the external part the sculpture on the posterior part of the last whorl is slightly interrupted by the alternation of the ribs; but on the anterior half of the last whorl the ribs run in undiminished strength and uninterruptedly across the external part.

Sutures.—Not known.

Dimensions.—

Diameter	32	mm.
Height of the last whorl	15	„
Thickness „ „ „	11	„
Width of the umbilicus	6	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

11. Parajuvavites buddhaicus, E. v. Mojs., Pl. VIII., Figs. 1—5.

The inner whorls, excluding the penultimate, show normal outlines caused by their regular growth. Where the shell-diameter is 10 mm. they are already higher than they are wide and possess a well-inflated external part which gradually passes over into the sides which ascend towards the umbilical margin. The whorls are almost completely embracing, so that only a very narrow umbilicus remains open.

The body-chamber whorl takes an obliquely elliptical form in contrast to the inner whorls and shows in its anterior half a considerable widening of the umbilicus caused by its divergence towards the aperture. Taken as a whole the body-chamber whorl, looked at from the side, appears egg-shaped, whereby the aperture of the shell coincides with the longitudinal axis of the egg. The greatest compression, which is connected with a very considerable narrowing of the external part, lies thus opposite the mouth, half a whorl backwards. This compression, as may be seen especially on the incomplete example of the body-chamber in Fig. 3, is preceded by an inflected portion, in which the breadth of the external part visibly diminishes.

In the anterior half of the body-chamber whorl a depression again occurs, following which the breadth of the external part gradually increases again towards the aperture. At the mouth itself a slight lateral and external inflexion of the shell towards the lumen of the tube takes place.

The sculpture consists of very numerous, fine, transverse ribs which on the inner whorls in the middle line of the external part seem only to be very slightly weakened, so that they almost continuously cross the external part. The bundles which arise from the manner in which the ribs are forked are tripartite to quadripartite. The stronger stem-ribs of the simple bundles, however, close together in the region of the umbilicus with their neighbouring ribs, whereby pairs of bundles arise composed of two simple bundles of ribs.

On the body-chamber whorl there is as a rule on the external part a more or less pronounced interruption of the sculpture. In some forms, as, for instance, in that represented in Fig. 1, there arises on the strongly pointed external part a keel-like, smooth band by which the transverse sculpture coming alternately from both halves of the shell is interrupted. On the right side this band, confined to the posterior third of the body-chamber whorl, is bordered by a fine incised line. The ribs close together again on the external part, towards the aperture. The lateral sculpture is likewise subject to some variations on the body-chamber whorl. In the typical specimen, Fig. 1, coinciding with the commencement of the narrowing of the external part the stem-ribs are conspicuous. They are wide apart from one another, increase in breadth and are swollen, knob-like, at less than half the height of the sides. The considerably widening intercostal furrows, however, remain smooth, without showing separated secondary ribs. Only towards the outer margin the inserted secondary ribs appear then again, but disconnectedly, without being visibly joined to the stem-ribs. From their short course and their position these secondary ribs remind us of the marginal knobs of *Halorites*. Towards the aperture the connection between the primary and the secondary ribs is again noticeable, but the primary ribs are closer together and appear therefore more numerous. Specimens with remnants of the shell preserved (Fig. 3a) show distinct lines of growth on the broad stem ribs of the compressed portion. In other specimens as, for instance, in the variety represented in Fig. 2, the connection between the primary and secondary ribs is, it is true, not broken as in the typical forms, but the secondary ribs appear flattened and indistinct as compared with the primary ribs. The bundles are mostly quadripartite.

Sutures.—The suture-line shown in Fig. 3b is taken from the septum immediately preceding the body-chamber of a full-grown specimen. It is reduced in height compared with the sutures of the preceding chambers, so that the external saddle especially seems to be greatly widened at its base. The saddles are, on the whole, slender and the lobes wide. In the young the denticulation is very weak, so that one might almost speak of brachyphyll development (Fig. 5). The sutures take later the dolichophyll form.

The two halves of the external lobe, separated by a rectangular median projection, as well as the other lobes, are one-pointed. The external and the first lateral lobe reach about the same depth. Outside the umbilical suture are one to two auxiliary lobes. The external is the highest of all the saddles, but the height given to it in Fig. 3b seems to be somewhat exaggerated. Also the details of the highest point in the saddle are so far incorrectly represented as to show that no furcation into two branches of nearly the same height exists. The external saddle ends, moreover, as in the other species of *Parajuvavites*, with the principal stem, undivided at the top, whilst below the summit of the saddle, on the external part, a larger lateral branch frees itself, which in the drawing has been drawn too high.

The length of the body-chamber comprises an entire whorl.

Dimensions.—

Diameter	63 mm.
Height of the last whorl	28 „
Thickness „ „ „	18·5 „
Width of the umbilicus	6 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 32.

12. PARAJUVAVITES STOLICZKAI, E. v. Mojs., Pl. IX., Figs. 2, 3.

The species here described, which of all the forms known up to the present time seems to be the one most closely related to *Parajuvavites Blanfordi*, is distinguished from that species, as well as from all other species of the genus *Parajuvavites* by the proportionally widely opened umbilicus. In contrast to the narrowly-umbilicated chambered casts of other species, the umbilicus in *Parajuvavites Stoliczkai* is already pretty widely opened on the casts of the inner whorls. After the beginning of the umbilical opening, which is connected with a stronger compression of the sides, the width of the umbilicus increases in a greater degree on the anterior half of the mature body-chamber whorl. On account of the relative width of the umbilicus of the inner whorls the umbilical opening is not so striking in its appearance as in species with narrowly umbilicated inner whorls.

The two figured specimens somewhat differ from each other in the outer form as well as in the ornamentation, and are to be regarded as varieties of one species. The narrower form, Fig. 2, Pl. IX, possesses more numerous ribs and appears in consequence more closely ribbed than the other (broader) one, Fig. 3, which is provided with stronger ribs following one another at wider intervals. Slight differences between the two varieties also exist in reference to the mode of division of the ribs. The tripartite division of the ribs prevails over the bipartite in the more finely ribbed variety, whilst in the more coarsely ribbed variety the reverse of this takes place. The place of division in the latter, towards the end of the last whorl, is farther outwards, and not rarely the divisions assume the character of intercalations in both varieties.

The ribs coming alternately from both halves of the shell are interrupted on the external part by a smooth band, which in the coarsely ribbed variety increases in width on the anterior half of the last whorl. Whether the ribs close together on the external part near the aperture in this variety as is the case in the finely ribbed variety, Fig. 2, cannot be determined on account of the incomplete preservation of the specimen represented in Fig. 3.

It must be remarked, however, that after the beginning of the divergence of the umbilical margin towards the aperture the sides, in their lower half, lose the inflation which they had shown before and become quite flat.

Variations in size are also to be observed in *Parajuvavites Stoliczkai.* There is a nearly complete finely ribbed specimen, provided with a body-chamber whorl, 41 mm. in diameter, in which towards the anterior end of the last whorl the ribs on the external part close completely together.

Sutures.—Not known.

Dimensions.—

Diameter	78 mm.
Height of the last whorl	33 „
Thickness „ „ „	9 „
Width of the umbilicus	16 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 5.

13. PARAJUVAVITES, n. f. ind., Pl. IX., Fig. 1.

The last whorl of the specimen figured belongs for the greater part to the body-chamber, but as the anterior half of the body-chamber whorl is wanting it cannot be determined whether we have to deal with an incomplete full-grown, or with an incomplete young form. It appears, however, as if the umbilical opening would begin near the anterior broken margin, for the sides become here flatter and the curvature of the umbilical margin seems to change its course. In that case one would be dealing with an incompletely-preserved full-grown specimen which might be related to *Parajuvavites Jacquini.* At the beginning of the last whorl the thickness is still greater than the height, but at the end of it (where, as mentioned, probably the umbilical opening begins with the compression of the whorl) this condition has changed. The height has become somewhat greater than the thickness. The umbilicus is open and proportionally wide.

But the most striking feature consists in the conspicuous sigmoidal curvature of the ribs on the sides, which are narrowest near the umbilical margin and increase considerably in width towards the outer margin. The intercostal furrows are very wide, so that, as a rule, bifurcated ribs are not very numerous.

An interruption of the alternately-appearing ribs takes place on the truncated external part as far as the chambered part of the shell extends. On the body-chamber, on the other hand, the ribs close together in the middle of the external part in a pointed angle.

Sutures.—Saddles and lobes have a brachyphyll denticulation. There is an auxiliary lobe outside the umbilical margin.

Dimensions.—

Diameter	33 mm.
Height of the last whorl	17 „
Thickness „ „ „	14 „
Width of the umbilicus	4 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

4. JUVAVITES, E.v.Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 74.

The genus *Juvavites* in the wider sense (or the "Juvavitinæ," as may probably be said when the knowledge of the group becomes more extended) is represented in the Indian trias by some indeterminable remnants of *Juvavites*, s. str., coming from the Daonella beds and the Hauerites beds, by some species of *Anatomites* and finally by a peculiar type allied to *Juvavites*, s. str., which will bear the designation *Griesbachites*. This new sub-genus is distinguished by marginal knobs, which already appear on the chambered whorls. In several species of *Juvavites* and *Anatomites* such marginal "ears" show themselves on the body-chambers of adult individuals; but in *Griesbachites* these marginal "ears," as above mentioned, are also present on the inner, chambered casts.

Griesbachites Medleyanus may be taken as the type of the genus. In the Mediterranean trias the genus is likewise known, but is very rare (G. *Kastneri*, Ceph. der Hallst. Kalke, II Bd., p. 95, Taf. CXCVI., Fig. 3).

Whilst the sutures show the closest relationship between *Griesbachites* and *Juvavites*, the presence of marginal knobs in the genus *Griesbachites* indicates a certain morphological agreement with knob-bearing forms of the group of *Sagenites reticulati*, from which, however, they are distinguished by the absence of longitudinal striæ.

a. ANATOMITES.

1. JUVAVITES (ANATOMITES) BAMBANAGENSIS, E. v. Mojs., Pl. XI., Fig. 1.

This species is allied to *Anatomites rotundus* (Ceph. der Hallst. Kalke, Bd. II, p. 98, Taf. LXI., Figs. 6, 7, 8, 9; Taf. LXXVI., Fig. 11; Taf. CXCVI., Fig. 11), from which it is distinguished especially by the disappearance of the paulostome ribs on the body-chamber. To this latter belongs about half of the anterior part of the last whorl, on the figured specimen, so that at least half a whorl is still wanting. Specimens with completely preserved body-chamber might therefore show no paulostome ribs at all on the last whorl by which they could foreshadow the appearance of a *Juvavites* from the group of *Interrupti.*

The present form agrees perfectly with *Anatomites rotundus* in its outer shape; but some deviations are shown in the sculpture of the chambered part of the shell. It is first to be remarked that in *Anatomites bambanagensis* the ribs are more numerous and much finer, whereby the intercostal furrows become narrower and flatter. The rib behind the paulostome furrow is more strongly inflated. On its posterior side two furcated ribs as a rule free themselves, so that it becomes tripartite. Owing to the fact that the forked rib preceding it joins it towards the umbilical margin a bundle of quinquepartite ribs may arise.

The number of the paulostome furrows occurring in the circumference of one whorl must have been considerably greater than in *Anatomites rotundus,* for in the posterior half of the last whorl in the specimen figured four paulostome furrows are still to be seen, whilst in *Anatomites rotundus* three to four paulostomes only occur in the circumference of a whole whorl.

The number of the ribs and the mode of their division vary in each area formed by the paulostome. The prevailing tendency is that the ribs which at first furcate outside the umbilical margin undergo yet another furcation farther outside, whereby bundles of tri- to quadri-partite ribs arise which likewise may fuse at their base on the umbilical margin. The paulostomes are divided by single ribs of normal strength. After the disappearance of the paulostomes the above-mentioned mode of division of the ribs becomes the prevailing one.

The transverse sculpture seems to be slightly interrupted on the middle line of the external part, though the ribs come from both sides correspondingly (not alternately). A slight weakening is also noticeable on the stronger ribs preceding the paulostomes.

Sutures.—Not known in detail. The degree of denticulation is about the same as in *Anatomites rotundus.*

Dimensions.—

Diameter	23 mm.
Height of the last whorl	12 „
Breadth „ „ „	18 „
Width of the umbilicus	2·5 „

Locality and Geological Position.—Carnic Stage; in the Daonella beds of the Bambanag Section. Number of specimens examined, 1.

2. Juvavites (anatomites) eugenii, E. v. Mojs., Pl. XI., Fig. 3.

The small chambered cast, with outlines similar to those of *Anatomites Caroli,* shows in the circumference of the last whorl only three paulostomes, which are however tolerably wide and divided by unforked middle ribs. The foremost of these paulostomes is only recognisable at its commencement on the anterior broken margin in the vicinity of the umbilicus. The number of the ribs occurring in the areas between the paulostomes is a very considerable one, as above 14 to 15 fine, sharp-edged, little ribs are present in the single bundles of ribs. It is further very noteworthy that behind the first paulostome in the posterior part of the last whorl the bundle of the ribs has a chain-like appearance, but in the next following anterior bundle this is not the case. Such chain-ribs have elsewhere been observed in the group of *Anatomites intermittentes* (cf. *Anat. Frechi*, *Anat. Hyppoliti*, *Anat. dimidiatus*, *Anat. Beyrichi*, etc.)

With the exception of stronger paulostome ribs which close together on the external part, the ribs of the bundles occur alternately in the middle line of the external part. This interruption of the ribs runs like a smooth band through the whole length of the bundle to the paulostome ribs. The direction of the paulostome furrows is obliquely inclined towards the anterior.

Sutures.—Not known in detail.

Dimensions.—

Diameter	11·5 mm.
Height of the last whorl	5·5 „
Thickness „ „ „	6·5 „
Width of the umbilicus	1 „

Locality and Geological Position.—Carnic Stage; pyritised in the Daonella beds of Rimkin Paiar. Number of specimens examined, 1.

3. JUVAVITES (ANATOMITES) CAROLI, E. v. Mojs., Pl. XI., Fig. 2.

This species is comparable with *Anatomites subrotundus and Anatomites Brochii* from the Julian deposits of the Röthelstein, near Aussee.[1]

Anatomites subrotundus shows special resemblance to the species here described, agreeing with it also in the outline of the shell. But the number of the paulostomes as well as the number of the ribs occurring in the areas between the paulostomes differ and thus necessitate the form represented being made an independent species.

In the circumference of the last chambered whorl there are four paulostomes divided by unforked middle ribs. The division of the bundles of ribs between the paulostomes is eleven- to twelve-fold. The ribs appear to be very narrow and sharp-edged, and the intercostal furrows broad. The paulostome ribs as well as those ribs nearest to them curve over the external part with a convexity turned somewhat anteriorly.

Though both halves of the shell are formed symmetrically and the ribs correspond in direction, they have, on the external part in the middle line, a slight interruption which is likewise still faintly indicated in the paulostome ribs which are more strongly inflated on the external side.

The preceding whorl, seen in Fig. 2b, appears as in *Anatomites rotundus* (Ceph. d. Hallst. Kalke, II. Bd., Taf. 196, Fig. 11), excepting the distinctly developed paulostomes, to be smooth shelled, or provided only with faint indications of transversely running folds in the areas between the paulostomes.

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[1] Cephaloden der Hallstätter Kalke, Bd. II., pp. 103 and 104, Taf. XC., Figs. 5 and 10.

Sutures.—Not traceable in detail.

Dimensions.—

Diameter	21 mm.
Height of the last whorl	11·5 „
Thickness „ „ „	12 „
Width of the umbilicus	1·8 „

Locality and Geological Position.—Carnic Stage; silicified, in the Daonella beds S. E. of Rimkin Paiar. Number of specimens examined, 1.

b. GRIESBACHITES.

GRIESBACHITES MEDLEYANUS, STOLICZKA, Pl. X., Fig. 2.

1865. *Ammonites Medleyanus,* Stoliczka, Geological Sections across the Himâlayan Mountains. Mem. Geol. Survey of India, Vol. V., p. 54, Pl. IV., Fig. 5.

1892. *Sagenites Medleyanus,* E. v. Mojs., Vorläufige Bemerkungen über die Cephalopoden-Faunen der Himalaya-Trias. Sitzungsber. kais. Akad. d. Wiss. Math.-naturw. Cl., Bd. Cl., Abth. I, p. 5.

1893. *Sagenites Medleyanus,* E. v. Mojs., Cephalopoden der Hallstäter Kalke, Bd. II., p. 157.

Stoliczka's original specimen, here figured anew, represents a chambered cast.

The widely expanding shell only possesses a narrow umbilicus from which the overhanging inflated umbilical wall rises rather steeply to the rounded umbilical margin. The whorls are somewhat higher than wide, and are inflated moderately on the sides, but strongly so on the external part, with the greatest width near the umbilical margin.

The sculpture is only faintly indicated on the sides by very flat, scarcely perceptible folds, of whose possible mode of division nothing definite could be said. In contrast to this faint sculpture on the sides stands the tolerably strong and distinctly developed sculpture on the external part which begins in the spiral of the marginal tubercles distinguished by their remarkable size.

In the circumference of the last whorl there are fourteen marginal tubercles, while the number of the ribs on the external part seems to exceed fifty. The connection of the ribs with the marginal tubercles on the external part occurs only alternately, there being intervals of from two to three ribs without tubercles. This is shown in such a manner that one or two ribs run out from the marginal tubercles. The ribs on the external part run (forming a very slight anteriorly directed curvature) nearly continuously across the external part, in the middle line of which a slight weakening of the ribs becomes noticeable.

Sutures.—The existence of distinctly individualised auxiliary lobes, as well as the regular gradual decrease in size of each of the sutural elements in the direction of the umbilical suture from the external part are among the features which the present species has in common with other species of *Juvavites,* especially of the group of *Juvavites interrupti,* as, for instance, *Juvavites interruptus, Juvavites subinterruptus.*

The number of septa occurring in the last chambered whorl, where the shell has a diameter of 92 mm., amounts only to nine. As in spite of this the saddles of the posteriorly lying septa touch the lobes of the septa which immediately succeed them anteriorly, the lobes and saddles are very long and narrow.

The external lobe, which is somewhat shorter than the first lateral lobe, occupies, as is seen in the front view, Fig. 2b, a considerable breadth. It is divided into two points by a broad, tolerably high median projection which is depressed in the middle. The points incline towards the succeeding external saddles. Similar median projections are found pretty frequently in *Juvavites*, and have also been observed in the trachyostracan genera *Halorites*, *Sagenites*, *Tibetites* and *Hauerites*.

The lateral and auxiliary lobes end in one point, but the lateral lobes also possess shorter lateral points, which added to the deep middle point produce a three-fold division. The number of the auxiliary lobes external to the umbilical margin amounts to two. Internal to the umbilical margin a third auxiliary lobe succeeds and a fourth meets the umbilical suture.

The saddles are distinguished by a great number of lateral branches, which proceed from the long and slender stem. Above they end with three larger lappets.

Dimensions.—

Diameter	92 mm.
Height of the last whorl	51 „
Thickness „ „ „	44 „
Width of the umbilicus	8 „

Locality and Geological Position.—Horizon and Locality unknown, probably from the "Daonella beds" (dark limestone). Number of specimens examined, 1.

2. GRIESBACHITES HANNI, E. v. Mojs., Pl. X., Figs. 3-5.

Of this interesting form there are unfortunately only more or less fragmentary specimens before me, which are also partly distorted by pressure. To these belongs also the apparently still completely chambered specimen, Fig. 4, in which the umbilical margin is, on account of the compression it has undergone, more strongly marked than in the other fragments under consideration.

The shape of the shell seems in the more inflated variety, Fig. 3, to agree in general with the outline of *Griesbachites Medleyanus*, while the typical form, Figs. 4 and 5, possesses somewhat flatter sides and a distinct, subangular, umbilical margin. The thicker variety, as well as the type, is distinguished from *Griesbachites Medleyanus* besides by the considerably greater width of the umbilicus. But the nature of the ornamentation constitutes the most important distinction between *Griesbachites Hanni* and *G. Medleyanus*. The presence of a strong well-developed sculpture on the sides of the shell may in the first place be pointed out. A further striking feature of *Griesbachites Hanni* is to be found in the greater number of marginal tubercles.

The sculpture on the sides consists of strong, slightly sigmoidal ribs which increase below the middle of the sides by bifurcation or intercalation and which are mostly ornamented on the margin of the external part by more or less strong marginal tubercles. The increase of the ribs by division or intercalation is as a rule effected in such a way that the ribs are only bifurcated. But sometimes tripartite ribs represent one stem-rib running out from the umbilical margin.

In the fragment represented in Fig. 5, but only on the left half of the shell, a paulostome furrow was observed which caused certain deviations in the course, and in the division, of the succeeding ribs. The paulostome runs radially perfectly straight. The anterior paulostome rib joins the next following stem-rib to form a pair of ribs which each constitute further towards the external part a secondary pair by bifurcation. The short rib bifurcating from the straight paulostome rib, exceptionally high above the middle of the side, takes a forward bend which corresponds with the sigmoidal course, while the succeeding stem-rib which bifurcates lower than the paulostome rib is distinctly sigmoidal.

The marginal tubercles occur on the inner whorls regularly on each rib reaching the external margin, but they are only slightly developed and represented by thickening of the ribs. Further outwards on the outer whorls an alternation of the marginal tubercles occurs chiefly caused by the stronger swelling of each second rib.

With respect to the strength and closeness of the ribs on the sides, Figure 4 represents the mid-point between the extremes observed and Figure 3 shows the closest ribbing. The ribs in the middle of the external part are more or less distinctly interrupted. This depends upon whether the sculpture on the two halves of the shell exactly corresponds or not. Where the ribs distinctly alternate as in Fig. 5, the interruption in the middle of the external part is much more marked. At the more strongly swollen marginal tubercles it is not rare to meet with paired bifurcations of the ribs on the external part.

Satures.—Not known.

Dimensions.—These cannot be measured on account of the fragmentary state in which the specimens occur.

Locality and Geological Position.—In the dark slaty limestone of the Daonella beds of Lauka, number of specimens examined, 3; in the horizon No. 4 of the Daonella beds of the Bambanag Section, number of specimens examined, 1.

5. ISCULITES, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II., p. 64.

1. ISCULITES HAUERINUS (Stol.).

1865. *Clydonites Hauerinus*, Stol., Mem. Geol. Survey of India, Vol. V, Part 1, p. 50, Pl. IV, Fig. 3.
1895. *Isculites Hauerinus*, Diener, Palæontologia Indica, Ser. XV, Vol. II, Trias, Part 2, p. 39, Pl. XXVII, Fig. 3; Pl. XXXI, Fig. 11.

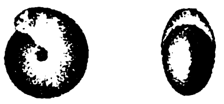
As already mentioned in the Introduction, it is not probable that this species belongs to the Anisic Stage. It is more probable that *Isculites Hauerinus* originated in a horizon of the upper trias. But as in the Mediterranean trias

Province the genus *Isculites* was found in the Carnic as well as in the Juvavian (Lacic) deposits, it is not possible to pronounce an opinion with reference to the occurrence of *Isculites Hauerinus* in any special horizon of the Indian trias; it must be left to further discoveries to solve the question.

2. Isculites cf. Heimi, E. v. Mojs.

1893. *Isculites Heimi*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 67, Taf. LXXXVII, Figs. 8, 11, 12, 13.

This small shell, provided with a complete body-chamber whorl and mouth-margin, is related to the var. *obesa* of *Isculites Heimi*, from which it is only distinguished by its somewhat smaller dimensions. The expanding mouth-margin is well preserved. Near the aperture there are some transverse folds crossing the sides and the external part.



Isculites cf. Meimi (Natural size).

Sutures.—Not known.

Dimensions.—

Diameter	11	mm.
Height of the last whorl	4	„
Thickness „ „ „ „	7	„
Width of the umbilicus (at the opening)	3	„

Locality and Geological Position.—Carnic Stage; in the Crinoidal-Limestone with *Trachyceras tibeticum*, from Rimkin Paiar. Number of specimens examined, 1.

6. Sagenites, E. v. Mojs., cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 155.

1. Sagenites, n. f. ind., Pl. XI, Fig. 10.

The extraordinarily high-mouthed form here figured is unfortunately represented only by a single specimen whose preservation is not very favourable for investigation.

The whorls are more than twice as high as they are wide, and expanded, so that only a narrow umbilicus remains open provided with a rounded margin. The sides are flattened and incline from the umbilical margin, where the whorls reach their greatest width, towards the outer margin. The narrow external part is rounded. Obscure fold-like transverse ribs, running tolerably radially, are noticeable on the sides. On the external part they undergo an increase, mostly probably caused by bifurcation. No interruption of the sculpture seems to occur on the external part. The longitudinal ornamentation consists of faint broad longitudinal striæ, which are not evenly disposed, apparently a consequence of the state of preservation. The transverse as well as the longitudinal ornamentations are only very slightly developed, and the present species reminds us, on account of this feature, chiefly of *Sagenites inermis* (Cf. Cephalopoden der Hallstätter Kalke, Bd. II, Taf. 95 und 96).

Sutures.—The preservation of the sculpture did not permit of the suture-line being exposed more than had already been done by the breaking off of part of the shell in the anterior portion of the last whorl preserved.

There is a marked dolichophyll development of the sutures, somewhat as it occurs in the more strongly serrated Juvavian *Sagenites.* Besides the three principal saddles there may be still one or two auxiliary saddles outside the umbilical margin.

Dimensions.—

Diameter	66 mm.
Height of the last whorl	39 „
Thickness „ „ „	15 „
Width of the umbilicus	3 „

Locality and Geological Position.—Carnic Stage; in the Daonella beds of the Bambanag Section (No. 2). Number of specimens examined, 1.

2. Sagenites, n. f. ind., Pl. X, fig. 6.

The figured completely-chambered fragment belongs, in all probability, to a new species, but on account of its incompleteness it is preferable to refrain from the imposition of a new specific name.

The penultimate whorl completely resembles a species from the group of *Sagenites inermis,* for it shows only fine transverse ribs but not yet any indication of longitudinal striation, which gradually gets strongly developed on the last whorl. The transverse ribs are also very well developed on the last whorl. They are distinguished by their sigmoidal curvature, as well as by the tendency to become stronger towards the external part which they traverse continuously. The division of the ribs does not often occur below the middle of the sides.

The external part is narrow. The greatest width of the volution is attained in the lower half. The umbilical margin is very sharply defined, the umbilical wall overhanging a little.

Sutures.—Of these only the large median projection of the external lobe, parts of the external saddle and of the first lateral lobe are visible. The last is distinguished by a larger median point, similar to that of *Sagenites princeps* and *Sagenites reticulatus.*

Dimensions.—Not measurable.

Locality and Geological Position.—Juvavian Stage; in the Limestone bed with *Pinacoceras* cf. *imperator*, No. 6 of the Bambanag Section. Number of specimens examined, 1.

3. SAGENITES, n. f. ind., Pl. X, Fig. 7.

The fragment of the external part here figured belongs to an undeterminable species which is related to *Sagenites quinquepunctatus* and *Sagenites Schaubachi*. A broad keel-like band occupying the middle of the external part, which is bounded on each side by narrower and feebler bands and ornamented with tubercles, distinguishes the present form from *Sagenites quiquepunctatus* (Ceph. d. Hallst. Kalke, II. Bd., p. 165, Taf. XCVII, Fig. 2, Taf. CXXV, Fig. 3), which in every other respect comes nearest to it, except that it is much thicker. Besides these external tubercles there occur other rows of tubercles, so far as the fragmentary state and the unfavourable condition of preservation permit of their recognition. The longitudinal striæ are very strongly developed, so that at their intersection with the transverse striæ little tubercles are here also formed.

The preceding whorl, judging by the mark of it in the zone of impression of the last whorl, seems not to have possessed any other kind of tubercles besides the small tubercles formed by the reticulations of the striæ.

Sutures.—Unknown in detail.

Dimensions.—Not measurable.

Locality and Geological Position.—The present fragment is derived from the beds (No. 9) rich in bivalves, at the base of the high mountain limestone of the Bambanag Section.

4. SAGENITES ind.

From the *Tropites*-Limestone of Kalapani there is a fragment of the side of a *Sagenites*, which might perhaps be placed near *Sagenites inermis* (Ceph. d. Hallst. Kalke, II. Bd., Taf. XCV, Figs. 2-5, 9-18, Taf. XCVI, Figs. 1-2). The fragment, however, is not sufficient to enable one to come to a tolerably certain decision even about its specific position. It seems, however, to point that the occurrence in the Tropites-Limestone of a form identical with *Sagenites inermis* or very nearly related to it is here indicated.

It should be further remarked that besides the few transverse ribs there are also faint traces of a longitudinal striation.

b. DIDYMITIDÆ.

DIDYMITES, E. v. Mojs.

1875. *Didymites*, E. v. Mojs., Das Gebirge um Hallstatt, Bd. I., p. 151.

This completely isolated genus was up to the present time reckoned among the Leiostraca. The globose shape of the shell, which shows a great analogy with

Proarcestes, its almost smooth surface and the strong development of epidermidae, seemed indeed to point that *Didymites* belonged to the same large group in which the similarly formed smooth shells, like the Arcestidæ (in the stricter sense) and the Joannitidæ are classed. But there are also many analogies with the Tropitidæ, so that the question may be raised whether *Didymites* should not perhaps more correctly find its place with the *Trachyostraca*.

In the first place the peculiar shape of the suture-line points to *Trachyostraca*, a fact to which Haug[1] has already directed attention. In spite of the considerable involution the number of the sutural elements is very small and their development is decidedly brachyphyll so that the habit on the whole approaches very much the sutures of *Trachyostraca* forms in the brachyphyll stage.[2] Only the peculiar development of the double saddles gives an unusual appearance to *Didymites* and reminds us of the dimeroid development of certain leiostracan types. But in some trachyostracan forms also similar secondary divisions are found; it is true, however, that they are only confined to the external saddle, as, for example, in *Tibetites*. A further peculiarity of *Didymites* is offered in the strongly developed lines of growth, which in their course remind us very much of the radial sculpture of true *Tropites*, whilst in the Arcestidæ and Joannitidæ the shells are mostly quite smooth and only show very faint traces of lines of growth.

Didymites would in the division of *Trachyostraca* certainly take up a very isolated position, but nevertheless views as to the possibility of a relationship to known types could there be more easily formed than in the division of the *Leiostraca*; for the Arcestidæ as well as the Joannitidæ already possess richly foliated sutures in the Anisic and the Fassanic periods. *Didymites* might have developed from the Haloritidæ by the gradual loss of the transverse sculpture and by the division of the saddles, and certain faintly ornamented Juvavitidæ, as, for instance, *Juvavites* (*Anatomites*) *Bacchus*, might be thought related to the ancestors of *Didymites*. From the experience gained up to the present time *Didymites* is confined to the Alaunic sub-division and can therefore be regarded as a very characteristic type of this period.

DIDYMITES AFGHANICUS, E. v. Mojs., Pl. XX, Fig. 9.

The spheroidal shell consists entirely of chambered whorls which are considerably wider than high and embrace one another up to the narrow umbilicus. The sides and external part seem to be equally inflated and not marked off from each other. The rate of increase of the whorls is very slow, and consequently the width of the umbilicus augments very slowly too.

The shell, which on the last whorl is damaged by weathering, is on the penultimate whorl almost smooth and only covered with indistinct transverse striæ. As mentioned above the shell is chambered throughout, and so the shape of the body-chamber whorl remains unknown until further discoveries are made.

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[1] Bull. Soc. Géol. de France, 3 sér., Tom. XXII, p. 390.

[2] Cf. the sutures of *Juvavites* (*Anatomites*) *Bacchus*, Cephal. d. Hallst. Kalke, Bd. II., Taf. LXXXVII, Figs. 19-21.

Epidermidae.—A fractured place on the last whorl permits of the observation of extraordinarily fine transverse "wrinkle"-striæ on the surface of the penultimate whorl.

Sutures.—Up to the umbilical margin there are, on the whole, five saddles, of which the first three show the characteristic didymitic division. A strong double saddle, divided in the middle by a single deep pointed indentation, takes the place of the external saddle. The outer of the two branches—the one nearest to the external lobe—shows only a slight brachyphyll serration, whilst the inner branch shows more numerous serrations. The two following saddles are extraordinarily narrow, and only split into two in the middle of the upper portion by a shorter one-pointed indentation. The two succeeding smaller saddles directed towards the umbilical margin likewise possess a rectangular outline but are not divided above.

Among the *Didymites* of the Mediterranean Province *Didymites sphæroides* (E. v. Mojsisovics, Ceph. d. Hallst. Kalke, I. Bd., p. 153, Taf. LX, Fig. 10) may from the structure of the sutures be placed nearest to *Didymites afghanicus.* In the details, however, several differences are observed, especially in the third double saddle, which in *Didymites sphæroides* is distinctly broader and at the same time more deeply indented, as may be seen by a comparison of the figures.

Dimensions.—

Diameter	44 mm.
Height of the last whorl	17 „
Thickness „ „ „	25 „
Width of the umbilicus	4 „

Locality and Geological Position.—Found loose in a black limestone in the Mazarghan stream, about 7 miles south of Hindubágh, in the Zhob Valley (Baluchistan). Number of specimens examined, 1.

c. TROPITIDÆ.

1. Tropites, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 184.

1. Tropites kalapanicus, E. v. Mojs., Pl. XI, Fig. 8.

This fossil, somewhat distorted by pressure in the rocks, possesses only a very slight remnant of the shell and in the greater part of the last whorl shows the body-chamber. It might therefore represent a tolerably complete adult specimen in which only about one-fifth or one-sixth of the body-chamber is wanting.

The whorls are of about equal height and width and increase proportionally slowly, whereby a tolerably wide umbilicus remains open. The external part is truncated and provided with a strongly developed keel sunk between keel-furrows.

The sides are somewhat inflated. The body-chamber is distinguished from the chambered part of the shell by the strikingly rapid appearance of a very strong development in the transverse sculpture. The chambered parts of the shell show a very close, fine sculpture of the type of *Paratropites* as in *Tropites Sellai* or *Tropites Saturnus*, which at the beginning of the body-chamber quickly assumes the robust character mentioned above owing to the increase in width of the ribs and intercostal furrows. On the chambered parts of the shell three, sometimes perhaps also four, ribs on the sides correspond to one umbilical tubercle. On the body-chamber the ribs divide in pairs, as a rule, outside the umbilical tubercle. On the anterior part of the body-chamber single ribs also run undivided, and others only divide towards the middle of the sides. On the chambered shell as well as on the body-chamber the ribs on the sides show a slight curvature, convex anteriorly, which is so characteristic of the sub-genus *Paratropites*. On the external part the ribs, strongly curved anteriorly, increase considerably in thickness.

Sutures.—The two lateral lobes with the brachyphyll developed saddles, represented in the illustration, are all that could be observed. This simple development of the suture-line is also characteristic of the sub-genus *Paratropites* (Cf. Ceph. d. Hallst. Kalke, II. Bd., p. 186).

Dimensions.—Cannot be measured on account of the distortion of the specimen.

Locality and Geological Position.—Carnic Stage; of the Tropites-Limestone of Kalapani. Number of specimens examined, 1.

2. TROPITES, n. f. ind., cf. acutangulus, E. v. Mojs., Pl. XI, Fig. 4.

1893. *Tropites acutangulus*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 203, Taf. CXII., Figs. 1, 2.

The figured specimen is apparently chambered up to the anterior broken edge, while a second specimen about a whorl larger seems to possess the body-chamber. Though these two specimens have suffered somewhat by distortion and are drawn out obliquely, they nevertheless show a close resemblance to *Tropites acutangulus* from which they are distinguished especially by the greater height of their mouth and their considerably narrower umbilicus. The sculpture is also nearly the same, as feeble longitudinal striæ are also indicated on the cast. But it may be mentioned as a distinction that in the present species the ribs become much thinner and run much further on the external part towards the anterior than is the case in *Tropites acutangulus*. The curvature of the ribs on the sides is the same in both species. Bifurcations of the ribs occur regularly at the umbilical tubercle and sporadically also further out on the sides and even on the external part. The keel on the external part is accompanied by two strongly developed keel-furrows.

Sutures.—As the lateral saddle reaches to the umbilical margin the suture-line is to be regarded as deficient and the lobe coinciding with the umbilical margin is to be considered as first auxiliary lobe.

Dimensions.—Not measureable on account of the distortion of the shell.

Locality and Geological Position.—Carnic Stage; in the Tropites-Limestone of Kalapani. Number of specimens examined, 2.

3. Tropites, n. f. ind., Pl. XI, Fig. 6.

This chambered fragment belongs to all appearance to a species from the group of *Tropites fusobullatus*, which is distinguished by the regular occurrence of bifurcations of the ribs on the external part. A first pair of bifurcations of the ribs takes place at the very strong umbilical tubercles. After the second bifurcation, already attained on the external part, a very considerable bending forward of the narrow branched part of the ribs occurs. Keel-furrows are scarcely recognisable.

Sutures.—Not known.

Dimensions.—Not measureable.

Locality and Geological Position.—Carnic Stage; of the Tropites-Limestone of Kalapani. Number of specimens examined, 1.

4. Tropites, ind., cf. fusobullatus, E. v. Mojs., Pl. XI., Fig. 5.

1893. *Tropites fusobullatus*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 194, Taf. CIX., Figs. 1—3.

The figured fragment is distorted on the outer whorl by compression, and the strong inflation of the external part results from the schematic re-construction of the compressed external part. This arises especially from the circumstance that on the anterior broken edge the external part shows a much slighter inflation.

The present more or less damaged and deformed fragments, all casts, show a great resemblance in shape and sculpture to *Tropites fusobullatus* and point to this species or to one very closely related to it. The whorls are considerably thicker than they are high, and reach, still provided with septa, very large dimensions. Their attachment seems to take place, as in the typical *Tropites fusobullatus*, outside the umbilical tubercles. The bifurcations of the ribs occur at the thick strong umbilical tubercles. The keel on the external part is sunk between deep keel-furrows.

As there are only casts available, nothing can be said about the character of the shell, especially as to the occurrence of longitudinal lines; but to judge by the somewhat indistinct impressions on the cast, longitudinal lines, however, which crossed the transverse sculpture seem to have been present.

Sutures.—Through the distortion already mentioned the sutures also appear somewhat deformed. The striking height of the lateral saddle is especially remarkable. The similarly abnormal depth of the external lobe, which the illustration shows, could not be verified. The suture-line agrees in other respects with the typical sutures of the bullate *Tropites*.

Dimensions.—Not measurable.

Locality and Geological Position.—Carnic Stage; in the gray rusty-brown Tropites-Limestone of Kalapani, Number of specimens examined, 3-5.

5. Tropites, ind., cf. Tropites discobullatus, E. v. Mojs., Pl. XI, Fig. 7.

1893. *Tropites discobullatus*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 212, Taf. CIV; Taf. CV, Figs. 2-4, 7.

This fragment, chambered throughout, is not sufficient for an exact determination, and on account of its bad preservation it is only figured in the front view. It is closely related to the group of varieties of *Tropites discobullatus*, but it is not possible at present to establish the identity of the Indian fossil with the European species. It appears as if the present fragment were broken off at the boundary between the chambered part and the body-chamber, in which case it might be compared with the smaller European varieties of *Tropites discobullatus*.

Sutures.—Not known.

Dimensions.—Not measureable.

Locality and Geological Position.—Carnic Stage; of the Tropites-Limestone of Kalapani. Number of specimens examined, 1.

2. Styrites, E. v. Mojs.

1893. Cephalopoden der Hallstätter Kalke, Bd. II, p. 264.

1. Styrites, f. ind.

A cast in brown iron-stone, 10 mm. in diameter, comparable by its shape with *Styrites subniger* (Ceph. d. Hallst. Kalke, II Bd. p. 277, Taf. CXXI., Fig. 34), already possessing a body-chamber. The sutures are not known. The specimen comes from the lowest division of the Daonella beds (Nos. 1, 2) of the Bambanag Section.

2. Styrites, f. ind.

A cast in pyrites, 11 mm. in diameter, chambered nearly up to the anterior broken edge, near which the body-chamber begins. By its shape this specimen, somewhat distorted by compression, reminds us of *Styrites communis* (Ceph. d. Hallst. Kalke, II Bd., p. 273, Taf. CXXI., Figs. 9—14). The sutures, however, are somewhat flatter than in the present species and approach those of *Styrites vermetus* (*loc. cit.*, p. 280, Taf. CXXI, Fig. 25) and *Styrites collegialis* (*l. c.*, p. 287, Taf. CXXI, Fig. 26).

Like the above-mentioned *Styrites* the species here referred to comes likewise from the lower Daonella beds (Nos. 1, 2) of the Bambanag Section.

3. Eutomoceras, Hyatt, cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 278.

1. Eutomoceras, n. f. ind., cf. Eutomoceras Plinii, E. v. Mojs.

1893 *Eutomoceras Plinii*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 289, Taf. CXXX., Figs. 4—6.

From the grey crinoidal limestone with *Trachyceras tibeticum*, of Rimkin Paiar, a chambered cast, somewhat distorted and weathered, of 85 mm. in diameter, lies before me. This may be compared in the first place with *Eutomoceras Plinii*, but must be referred to another species on account of the deviations in the sutures.

The shape and the nature of the sculpture agree in essential points apparently with *Eutomoceras Plinii*, so that a description of them may here be omitted.

Sutures.—The external lobe is considerably shorter than the first lateral lobe. The external saddle therefore lacks the large accessory indentations on the slope turned towards the external lobe, which are so characteristic of *Eutomoceras Plinii.* The number of auxiliary lobes is very considerable. But in consequence of the changes which the suture-line has undergone through weathering it is not possible to determine exactly whether a part of the indentations may not be considered as divisions of the saddle.

A badly preserved, small, chambered fragment which comes from the Daonella beds succeeding the crinoidal limestone with *Trachyceras tibeticum*, near Rimkin Paiar, might also belong to this species.

2. EUTOMOCERAS, ind. cf. EUTOMOCERAS SANDLINGENSE, F. v. Hauer.

1893. *Eutomoceras Sandlingense* (Fr. v. Hauer), E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II., p. 285, Taf. CXXX., Figs. 11-13 ; Taf. CXXXI., Figs. 1-11.

These are fragments not suitable for illustration and are very similar to the narrow- as well as to the broadly-ribbed varieties of *Eutomoceras Sandlingense* ; and it would, on account of their bad preservation, be impossible to give a more decided opinion as to their agreement with or deviation from the European type.

Locality and Geological Position.—In the Tropites-limestone of Kalapani.

d. SIBIRITIDÆ.

SIBIRITES, E. v. Mojs.

1886. *Sibirites*, E. v. Mojs., Arktische Triasfaunen. Mèm. de l'Acad. Imp. des Sciences de St. Pétersbourg, VII. sér., Tom. XXXIII., No. 6, p. 58.

1893. *Sibirites*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II., p. 327.

1895. *Sibirites*, Diener, Palæontologia Indica, Ser. XV., Himálayan Fossils, Vol. II, Trias, Part 2. The Cephalopoda of the Muschelkalk, pp. 37 and 104.

1895. *Sibirites*, Waagen, Palæontologia Indica, Ser. XIII, Salt Range Fossils, p. 104.

The species recently made known from the trias formations of the Salt Range, as well as from the trias of the Himálaya, increase our knowledge of this interesting genus to a considerable extent, so that it is necessary to enter anew into a discussion of it.

It must first be pointed out that owing to the species described by Waagen and Diener from the Dinaric deposits, the extent of the "Intermittent Period," as hitherto accepted on the ground of the knowledge yet possessed, is somewhat limited.

With the species described from the Olenek beds of Siberia are temporarily associated the numerous species of the Hydaspian Stage made known by Waagen from the Salt Range. The two species, *Sibirites Prahlada* and *Sibirites Pandya*, described by Diener from the Himálaya might be assigned to the Balatonian substage. The first named species comes from the chief zone of the Himálaya, whilst *Sibirites Pandya* was found in the red limestone of the Hallstatt development within the cliff regions of the Chitichun Chain in the Tibetan Province of Hundes.

The species of *Sibirites* of the Salt-Range though standing nearest to the Arctic species, *Sibirites Eichwaldi*, differ in many respects from the latter, so that they may be regarded as a characteristic group by reason of a tendency towards decided variation. To this group the sub-generic designation *Anasibirites* might be applied.

The species of *Anasibirites* is distinguished by narrow, rather rapidly increasing whorls, which possess a narrow, rounded or flattened external part. The ornamentation closes completely on the external part either describing a projecting external lappet (*Curvicostati*, Waagen) or traversing in a straight line the external part (*Rectecostati*, Waagen). Marginal tubercles are only faintly indicated in a few forms, but they are completely wanting in the greater number. The marginal tubercles never form raised edges, which make the middle region of the external part appear as a deepened furrow, as is the case with *Sibirites Eichwaldi*. In the lateral sculpture, the contrast between strongly developed chief ribs and weaker secondary ribs occurring in the interspaces of the chief ribs, which mostly appear as intercalated and more rarely as bifurcated ribs, is more or less striking. The tendency is thus shown to shift the place of division of the ribs from the margin towards the umbilicus. Where marginal tubercles are present they are only on the chief ribs. The lateral ribs show a tendency to curve sigmoidally, but in a few forms the curvature is only faintly indicated. The contrast between the primary and secondary ribs continues from the sides to the external part, in some species it being more sharply marked on the external part than on the sides. In a few species the sculpture disappears entirely on the body-chamber.

The two species described by Diener from the Anisian (Balatonian) deposits of the Himálaya are closely allied to *Sibirites pretiosus* and represent widely umbilicated, slowly increasing forms with low apertures, which also by reason of the the nature of the sculpture, are clearly distinguished from the forms designated as *Anasibirites* and may be considered, in all probability, as descendants of the *Pretiosus* stock. In *Sibirites Prahlada* (*loc. cit.*, p. 37, Taf. VII., Fig. 5), however, we already find a considerable approach to the types of the Lacic Hallstatt Limestone which we shall distinguish by the group-name ***Metasibirites***. To *Metasibirites spinescens Sibirites Prahlada* has a particularly close resemblance. In the place of the lateral spines there are in *Sibirites Prahlada* strongly developed crescentic tubercles, at which, as at the lateral spines of *Metasibirites spinescens*, the bifurcation of the ribs takes place. In striking contrast with *Metasibirites spinescens* the bifurcated ribs of *Sibirites Prahlada* extend in an oblique direction from the crescentic tubercles to the external part, on which they describe an arch the convexity of which is directed forwards. The ribs on the external part are no longer in contrast to those of the older *Sibirites* of the Olenek beds closed together in a pointed angle, alternating from both sides of the shell in the middle of the external part, but they form uninterrupted continuous arches as in *Anasibirites*.

With reference to the second species, *viz.*, *S. Pandya* (*loc. cit.*, p. 104, Taf. XXIX, Fig. 3) described by Diener we must make a reservation, as the length of the body-chamber is not known. In spite of the fact that this species agrees very closely in shape and sculpture with *Metasibirites*, it does not seem certain whether we have not to recognise in *S. Pandya* a form branching off from *Danubites*, which should find its correct systematic position near *Buchites*. But should it be considered justifiable to refer *S. Pandya* to *Sibirites*, the position of the bifurcation of the ribs close to the edge would be a feature reminding us of *Sibirites pretiosus*. In the true *Metasibirites*, on the other hand, the bifurcations of the ribs occur as a rule at the lateral spines or, where these are already obliterated in the middle of the sides, even lower. The bifurcation of the ribs quite at the margin, however, is a feature which characterises the forms occurring in the Lacic deposits of the Himálaya, forms provided with large marginal spines and described in the following pages, for which I shall introduce the sub-generic designation of *Thetidites*.

The species of *Thetidites* are slowly increasing widely umbilicated shells, with low whorls of rectangular section. The inner whorls show an ornamentation which is distinguished from that of the inner whorls of the European species of *Metasibirites* only by the marginal position of the spines, whilst in the species of *Metasibirites* provided with an inflated external part the spines are lateral from their position. Later, when the sides have become more individualised in their development, there occur partly connected-ribs which close together in pairs at the marginal spines (*Th. Huxleyi*), partly accessory ribs running divergently (*Th. Guidonis*). The external part is covered with fine ribs, describing a very slight convexity directed anteriorly and being slightly interrupted in the middle line. The ribs, partly paired, form the connection between every two opposite marginal spines, but they partly also occur in the intervals between every two of the succeeding marginal spines.

The sutures of this peculiar type, reminding us by its sculpture of *Cœloceras subarmatum* from the lias, are distinguished from those of the older *Sibirites* by the great depth of the two-pointed external lobe. The first lateral lobe coincides with the marginal spines, while the one-pointed second lateral lobe is within or on the umbilical margin. There are no auxiliary lobes.

The sub-genus *Metasibirites* occurring in the Lacic formations of the Alps comprises throughout (as is to be seen in the illustrations in the second volume of the Hallstatt Cephalopoda) small shells of concentrated growth and sculpture, the latter traversing the external part in a straight line. The lateral tubercles or lateral spines always present in the young pass in some species into umbilical tubercles in adults, while in other species they disappear entirely. As in the sub-genus *Anasibirites* single ribs are often more conspicuous on the external part (paulostome-ribs).

The genus *Sibirites* is on the considerations above set forth thus divided into the following sub-genera:—

1. *Sibirites*, s. str. (Jakutic-Anisic).
2. *Anasibirites* (Hydaspic).
3. *Metasibirites* (Lacic in the Mediterranean Province).
4. *Thetidites* (Lacic, in the Indian Province).

Metasibirites and *Thetidites*, from our present knowledge of them, appear to us as vicarious genera. *Metasibirites* has not been proved to be present in the trias of the Himálaya and the reported occurrence of *Metasibirites spinescens* in the *Halorites*-beds of the section at Rimkin Paiar rests upon an error. The specimen which was taken for *Metasibirites* (*Acrochordiceras* of Griesbach) is so badly preserved that even a generic determination cannot be arrived at.

1. THETIDITES HUXLEYI, E. v. Mojs., Pl. XI., Fig. 12; Pl. XII, Figs. 1—4.

The slowly increasing whorls embrace one another only on the broad, slightly inflated external part. They are considerably wider than they are high and in the young possess sides which obliquely slope towards the widely open umbilicus, but are flattened in the adults, so that then a nearly rectangular section results. In consequence of this difference the umbilicus appears deeper in the young but much flatter in the adult.

The body-chamber comprises the whole of the last whorl, as is to be seen in the large full-grown specimen represented in Fig. 1, in which the last sutures, closely set, are shown.

On the inner whorls the most striking element of the sculpture consists in the high marginal spines which are placed at the edge between the sides, sloping obliquely towards the umbilical suture, and the broad slightly inflated external part. In connection with the spines there are on the sides, sloping obliquely towards the umbilical suture, straight radially running transverse ribs, which in most of the present specimens are broad and fold-like in their development. Only in such individuals (*e. g.*, Figure 4, Pl. XII) as reach maturity when of small dimensions the transverse ribs are already early present in the shape of well individualised fillets. The external part of such internal casts looks, at first sight, perfectly smooth, and it is only by very close observation that one can see obscure indications of the later strongly developed external ribs.

The marginal spines, of which from 11 to 13 may be counted, are closed in their lower portion at a little height above their base, near the lumen of the tube; and this is to be judged by the fact that spines broken off at this place are not bordered by an irregularly fractured cicatrice, but by a smooth lamella-like surface imbricated the reverse way. This surface evidently corresponds with the closure which separated the spine from the lumen of the tube. Whether this was merely a partition (in which case the spine must be supposed to have been hollow), or whether the whole spine was solid up to that surface, could not be ascertained.

The period at which the sides, after the development of a rounded umbilical margin from the obliquely sloping position, become converted into well individualised ones reaching to the umbilical margin, plays an important rôle in the development of the individual. But this period occurs at very different dimensions of the shell as the comparison of the two forms teaches. They are represented in Figs. 3 and 4, and form a great contrast in their development. The formerly simple lateral ribs bifurcate for the greater number and form connected-ribs which close together in pairs at the marginal spines. Moreover the sculpture on the external part becomes more distinct and prominent. The ribs traversing the external part with only a slight curvature directed anteriorly and showing a faint median longitudinal indentation in some specimens, occur partly between every two marginal spines opposite one another on the two halves of the shell and partly in the interspaces between every two succeeding marginal spines. These ribs appear in both cases as connected ribs bifurcating at the margin, or else closing again. A modification of this development occurs if three ribs join the corresponding marginal spines of the two halves of the shell. In this case and in others also the rib on the external part occurring between two succeeding marginal spines is not bifurcated but simple. Isolated undivided ribs, not connected with any marginal spine, occur also on the sides, especially towards the aperture.

Irregularly undulating longitudinal lines occur also in some specimens at the external part of the body-chamber.

The transformation in the sculpture and the shape of the shell takes place in most of the specimens on the septate penultimate whorl. Only in a few forms which are perhaps to be regarded as not yet full-grown this critical period coincides with the beginning of the body-chamber (Cf. Fig. 3, Pl. XII).

Sutures.—Corresponding with the conditions of involution no auxiliary lobes present outside the umbilical suture, and on the whole five lobes may be counted outside this suture, *viz.*, the two lateral lobes of the left and right half of the shell, and the external lobe. The latter is divided into two one-pointed halves by a short median projection. The succeeding first lateral lobe is almost halved by the external edge. In some specimens the larger half of it is already on the sides. The point of this lobe which does not reach as deep as the external lobe coincides almost always with the large marginal spines and is therefore with difficulty to be observed in detail. As a rule there seem to be two indentations from which a three-pointed arrangement results. The second lateral lobe lies on the umbilical margin, sometimes also inside of it. It is only one-pointed and considerably shallower than the first lateral lobe.

The one-pointed internal lobe forms a long narrow point. The saddles are rounded above and with unbroken edges. The external and lateral saddles show in their lower part faint indentations, which seem to be a continuation of the indentations of the lobes.

The variety in which the sides become individualised at a late stage of growth (Fig. 3, Pl. XL) is remarkable for its strikingly low saddles.

Dimensions.—

Diameter	42 mm.
Height of the last whorl	13·5 „
Thickness „ „ „	15 „
Width of the umbilicus	19·5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 14.

2. THETIDITES GUIDONIS, E. v. Mojs., Pl. XI, Fig. 11.

This species is not only distinguished from the closely related *Thetidites Huxleyi* by the finer development of the sculpture, but also by other essential differences.

The internal cast, so far as it is visible in the umbilical opening, agrees with the internal casts of *Thetidites Huxleyi*, and like this species possesses simple, straight-running, lateral ribs and strong marginal spines. The sides also, as in the inner whorls of the species just named, slope obliquely towards the umbilical suture. But when compared with *Thetidites Huxleyi* there is here already a distinction to be noticed in so far as the marginal spines are weaker, finer and therefore also more numerous. A rounded umbilical margin which bounds the now individualised flattened sides towards the umbilicus is early formed.

But in contrast to *Thetidites Huxleyi* there are no connected ribs on the individualised sides. On the contrary, peculiar intercalations of ribs are shown which at first sight produce the impression of bifurcations. There appears, namely, close to the preceding radially-running chief rib, an accessory one, but already completely separated at the umbilical suture. Outside the umbilical margin, after a slight backward curvature, it turns, diverges strongly in an oblique direction towards the anterior and bears on the outer edge a marginal spine like those of the chief ribs.

The diverging ribs just described only occur alternately at irregular distances. There are about two simple ribs in the interspaces.

On the last whorl, forming the body-chamber, the diverging pairs of ribs gradually disappear. The numerous fine ribs, separated by broad intercostal furrows, are of varying strength and slightly concave towards the anterior. The marginal spines become feebler in the stronger ribs, disappearing entirely in the weaker ones. In the anterior part of the last whorl the sculpture becomes irregularly folded and true divisions of the ribs also occur.

The sculpture on the external part is of the same kind as that described in *Thetidites Huxleyi*, but with this difference, namely, that in ribs lacking the marginal spines no external divisions of the ribs take place.

Sutures.—The suture-line does not only agree in the general arrangement but also in the essential features with the sutures of *Thetidites Huxleyi*. Slight indentations are visible in the lower part of the walls of the external saddle and of the lateral one.

Dimensions.—

Diameter	34 mm.
Height of the last whorl	10·5 „
Thickness „ „ „	12 „
Width of the umbilicus	15·5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

B. CERATITOIDEA.

a. DINARITIDÆ.

1. DINARITEA.

1. Ceratites, de Haan.

Ceratites is only represented by the subgenera *Helictites* and *Thisbites*, but it must be mentioned that the determination of the genus *Thisbites* is for the present still doubtful.

a. Helictites, E. v. Mojs., cf. Cephalopoden der Hallstätter Kalke, Bd. II., p. 416.

Helictites atalanta, E. v. Mojs., Pl. XII, Fig. 5.

The widely umbilicated shell consists of rather quickly increasing whorls which are somewhat wider than high and embrace one another on the rounded external part. The sides are moderately inflated. In the transverse section of the whorls there is a great resemblance to *Helictites*, nov. f. ind. (Cephalopoden der Hallstätter Kalke, Bd. II., p. 420, Taf. CXXXIX, Fig. 2) from the Lacic Limestone of Leisling near Goisern, whilst the sculpture shows a close agreement with *Helictites Beneckei* (*loc. cit.*, p. 416, Taf. CXXXIX, Fig. 1) coming from the same horizon.

On the chambered whorls generally two of the slightly curved strong ribs, whose concavity is turned anteriorly, run in pairs together and form strong umbilical tubercles. The intercostal furrows seem to be tolerably wide on the cast. On the external part of the last whorl, three-fourths of which belong to the body-chamber, the ribs are close together, slightly curved towards the anterior part. Indistinct marginal and externally situated tubercles, which disappear entirely on the body-chamber, are to be observed on the still chambered posterior part of the last whorl in a symmetrical arrangement. There are indications of two rows of marginal tubercles, while, on the external part, outside its median line, towards the left, a row of knot-like swellings is noticeable.

Marginal and external tubercles have likewise been observed in the Mediterranean species *Helictites geniculatus.* As the ribbing of the two halves of the shell is not completely symmetrical the closing together of two ribs of the one half of the shell with only one rib of the other half takes place on the external part.

The ribs are wide apart on the body-chamber. The knot-like swellings on the umbilical margin persist nearly up to the mouth, where they disappear, but the paired divisions have ceased, and in their place, as the bifurcations advance on the sides, obscure bifurcations of the ribs occur, which assume the character of intercalations of secondary ribs.

Behind the margin of the mouth the considerably weakened fold-like ribs become crowded. Indications of faint spiral striæ are visible on the cast of the body-chamber.

Sutures.—External lobe deep, only a little shorter than the first lateral lobe, divided by a median projection rounded above and with an unbroken margin into two halves, notched into three points by two small indentations.

The first lateral lobe deep, considerably widening towards the upper part, two-pointed at the base by a median indentation, whilst a shorter point on either side inserts itself into the walls of the neighbouring saddles.

Second lateral lobe considerably shorter than the first, divided at the base into two points, coinciding by its position with the umbilical tubercle.

Saddles with an unbroken margin, rounded above. External saddle nearly as high as the first lateral saddle, slightly flattened above. The second lateral saddle sinks downwards on the umbilical wall.

Dimensions.—

Diameter	48 mm.
Height of the last whorl	16·5 „
Thickness „ „ „	17·5 „
Width of the umbilicus	19 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

b. THISBITES, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 429.

THISBITES (?) MELEAGRI, E. v. Mojs., Pl. XIV, Fig. 10.

Some difficulties present themselves in assigning this isolated form to its systematic position in one of the known genera. *Eutomoceras* is distinguished by the early beginning of the bifurcations of the ribs, and their slight curvature. In the genus *Thisbites*, distinguished likewise by a high external keel, marginal tubercles or lunulæ taking their place as a rule occur. But among the European representatives of this genus there are some species in which marginal tubercles as well as lunulæ are wanting, as, for instance, *Thisbites Borellii* and

Thisbites, nov. f. ind. (Cephal. d. Hallst. K., II Bd., p. 435, Taf. CXLII, Fig. 24). From Europe also *Thisbites* is known, in which, as in the present species, no bifurcations of any kind, or intercalations of ribs, occur, as, for instance, *Thisbites Haushoferi* (Cephal. d. Hallst. K., II Bd., p. 440, Taf. CXLII., Fig. 26). The habit of the present Asiatic form reminds us of the latter species, as well as of *Thisbites Anatolis* and *Thisbites Borni*, so that with the reservation demanded by the circumstances of the case we place it in *Thisbites*, without of course intending to exclude the possibility that we may perhaps have to deal here with a new genus.

The small shell is somewhat elongated, but we cannot decide whether this is due to a mechanical contortion of the rocks, or it is a character originally belonging to the species. The whorls are considerably higher than they are wide. They increase rapidly in height and embrace one another to the extent of about one half. The width of the umbilicus amounts to somewhat less than half the height of the whorl at the mouth of the last whorl. The inflated sides converge gradually towards the pointed external part, to which the high external keel seems to be applied. The keel is well individualised and not distinctly defined at its base.

The lateral sculpture consists of strong sickle-shaped ribs which run out on the external part thin and thread-like to the next succeeding rib, touching this latter, so that a continuous spiral line is formed in which the ribs meet. At the beginning of the last whorl the ribs are crowded. Later they are, however, wider apart, so that at the end of the last whorl wide intercostal areas occur. The ribs remain, as a rule, undivided. Only quite exceptionally bifurcations of the ribs occur near the umbilical margin.

Sutures.—Not known.

Dimensions.—

Diameter	14·5	mm.
Height of the last whorl	7·5	„
Thickness „ „	4	„
Width of the umbilicus	2·8	„

Locality and Geological Position.—Carnic Stage ; in black limestone, on the left side of Tera Gadh, North of Kalapani. Number of specimens examined, 1.

2. ARPADITES, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II, p. 450.

Of the eight sub-genera, which I have elsewhere identified, I could only establish five in the Indian trias. They are as follow :—

a. *Arpadites*, s. str.
b. *Dittmarites.*
c. *Clionites.*
d. *Steimmannites.*
e. *Dionites.*

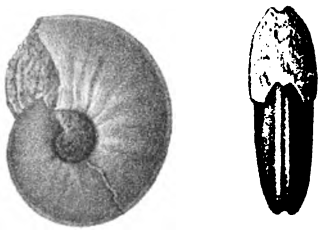
The genus *Arpadites* is in the wider sense a polyphyletic one which can be traced back to different *Ceratites* stocks. As soon as the appropriate *Ceratites* stock can be established for each single genus the genus *Arpadites* will be given up, and the genera into which it is divided will then be arranged according to their respective places in the system.

a. ARPADITES, s. str.

1. Arpadites Stracheyi, E. v. Mojs.

1865. *Ammonites floridus* (Wulfen) juv., Salter, Palæontology of Niti, p. 61, Pl. 8, Fig. 3 (but not Figs. 1, 2, and not Pl. 6, Fig. 1.)

A plaster model of Salter's original specimen preserved in the British Museum in London has been kindly placed at my disposal by Dr. Henry Woodward, and enables me to give here an illustration in its natural size of this very simple shell.



Arpadites Stracheyi.

From a plaster model of the original specimen from the Niti Pass. Natural size.

The whorls, embracing one another to the extent of about one half of their depth, are higher than they are wide and possess slightly inflated sides. The external furrow at the beginning of the last whorl is deeply sunk into the rounded smooth external part. But gradually the edges of the furrow, greatly increasing in width, rise into strong broad keels. The more marked individualisation of the external part through the presence of blunted marginal edges which separate the sides from the external part takes place simultaneously with the development of the keels.

The lateral sculpture is confined to slight indications of transverse folds which seem to arise through the scooping out of shallow depressions round the umbilicus, a circumstance whereby we are reminded of the process of construction of the ribs in the group *Arpadites rimosi* (cf. Ceph. d. Hallst. Kalke, Bd. II, Taf. CLIV, Figs. 2, 6; Taf. CLV., Fig. 1; Ceph. d. medit. Triasprovinz, Taf. XXV, Fig. 6). Indications of smaller, slightly curved, transverse folds are noticeable on the anterior half of the last whorl. The shell possesses an obliquely elliptical outline.

Sutures.—According to the figure of the suture-line given by Salter there are saddles with unbroken margin, rounded above, and rather flat lateral lobes with many indentations. Salter figures the external lobe only two pointed, indicating only one divergent point of the lobe on either side of the very rudimentarily-developed median projection. A flat hollowed-out auxiliary lobe with unbroken margin appears outside the umbilical edge.

Dimensions.—

Diameter	26	mm.
Height of the last whorl	11·5	„
Thickness „ „	8	„
Width of the umbilicus	6·5	„

Locality and Geological Position.—Carnic Stage; Niti Pass.

2. Arpadites rimkinensis, E. v. Mojs., Pl. XIV, Fig. 6.

This species represents a circumplicated type, not known up to the present in the Mediterranean trias region, which is distinguished from the most closely related group of forms of *Arpadites cinensis* (Ceph. d. medit. Triazprovinz, p. 56 f.) by the lack of umbilical tubercles.

The whorls, rather rapidly increasing in height, embrace one another to the extent of rather more than half their height. They are higher than they are wide. The sides are moderately inflated. The external part bears two high sharply defined keels which enclose the deep-sunk middle furrow.

The sculpture consists of narrow ribs succeeding one another at wide intervals. They are strongly raised as long as they radiate in a straight line, but they are much more feebly developed farther outside, where they distinctly bend towards the anterior part. In the wide interspaces between these strong ribs of which fifteen are present in the circumference of the last whorl, more feebly indicated secondary ribs occur, which are mostly to be regarded as intercalated ribs and only exceptionally as bifurcated ones. But the strength of the ribbing is subject to some variations, as in some specimens the intercalated secondary ribs almost reach the strength of the primary ribs, so that the shell then appears in this variety much more closely ribbed. At a diameter of 20 mm. a specimen of this variety bears 20 ribs in the circumference of the last whorl.

Sutures.—The sutures have a brachyphyll development in contrast to those of the group of *Arpadites cinensis* in the ceratitic stage of development and may be compared with the sutures of *Arpadites Ladon* (Ceph. d. Hallst. Kalke, II. Bd. Taf. CLIII., Figs. 6—7) from the Julian deposits, but the second lateral lobe is considerably deeper in *Arpadites rimkinensis* than in the species named above. The first auxiliary lobe is on the umbilical margin.

Dimensions.—

Diameter	23	mm.
Height of the last whorl	10·5	„
Thickness „ „ „	6	„
Width of the umbilicus	5·9	„

Locality and Geological Position.—Carnic Stage; in the crinoidal limestone of Rimkin Paiar. Number of specimens examined, 7.

3. Arpadites lissarensis, E. v. Mojs., Pl. XIV, Fig. 7.

The figured specimen which is distinguished by an obliquely elliptical oviform outline, represents a type which might find its natural alliance in the Mediterranean group of *Arpadites Arpadis*. The slight depth of the external furrow, accompanied by constantly occurring marginal spines, gives however a certain isolated position to the present species.

The whorls embrace one another only on the slightly inflated, rather flattened external part; they increase very slowly, so that in the widely opened umbilicus the whole height of the sides of the inner whorls is visible. The whorls are thus higher than wide.

The feebly developed external furrow is sunk in a broad keel-like longitudinal elevation of the external part, similar to that of *Steinmannites thisbitiformis* (Ceph. d. Hallst. Kalke, II. Bd., p. 484, Taf. CXLII, Figs. 7, 8).

The transverse sculpture is only feebly indicated on the inner whorls by flat indistinct folds. On the penultimate whorl the present fragment shows faint slightly curved ribs which are separated by wide intercostal spaces bearing small umbilical tubercles on the umbilical margin. In some cases two neighbouring ribs furcate at these tubercles, that is, weaker secondary ribs separate themselves from the stronger primary ribs. At the edge of the periphery all the ribs bear spines, from which the considerably weakened ribs on the external part bend obliquely forward, describing a short lappet. In traversing the keels which enclose the external furrow, the ribs form obscure tubercles.

On the outer whorl which in this fragment belongs to the body-chamber› small bifurcations of the ribs are shown. The ribs are considerably more closely set in the anterior part.

Sutures.—Not known in detail.

Dimensions.—

Diameter	35 mm.
Height of the last whorl	8·5 „
Thickness „ „ „	5 „
Width of the umbilicus, about	19 „

Locality and Geological Position.—Carnic stage; in grey limestone with *Joannites*, cf. *cymbiformis*, of the Lissar Valley, opposite the Ralphu Glacier. Number of specimens examined, 1.

b. DITTMARITES.

Arpadites (Dittmarites) Hindei, E. v. Mojs., Pl. XIV, Fig. 8.

As to this species one might, on account of its outward similarity to *Anasirenites Aristotelis* (Ceph. d. Hallst. Kalke, II. Bd., p. 780, Taf. CLII., Fig. 1), be in doubt whether to refer it to *Anasirenites* or to *Arpadites*. It is the group of *Arpadites rimosi* (sub-genus *Dittmarites*) in the genus *Arpadites* to which the present species seems closely related. The reasons that induce us to give the preference to the latter alternative are—(1) the flattened character of the transverse ribs, which are only separated from one another by narrow sharply-cut intercostal furrows; (2) the agreement in character of the umbilical margin with the group of *Arpadites rimosi* in contrast to the gently sloping umbilical area of *Anasirenites Aristotelis*; and (3) the absence of the longitudinal line occurring in the last-named species in the middle of the sides. *Arpadites Hindei* is in its entire habit allied to *Arpadites Ferdinandi* (Ceph. d. Hallst. Kalke, II. Bd., p. 459, Taf. CLIII., Figs. 15, 17), but has a much higher mouth and is more narrowly umbilicated. The external part is flatter, which is chiefly caused by the lesser height of the smooth external keels. The sides are covered with much more numerous, distinctly sigmoidally-curved ribs which form bundles at the tubercles on the umbilical margin. Through further bifurcations of the ribs occurring at less than half the height of the sides the number of ribs united to a bundle amounts to from 4 to 5. At the edge bordering the smooth external area from which the keels rise, the ribs become pointed. The occurrence of umbilical tubercles is repeated in the only species known up to the present time from the Juvavian formation, *viz.*, *Arpadites Lilli* (Ceph. d. Hallst. Kalke, II. Bd., p. 462, Taf. CLIII., Fig. 10.)

The great morphological agreement with *Anasirenites Aristotelis* above emphasized might lead one to think as to whether this species might not find a more suitable systematic position in *Arpadites*. But while the occurrence, as already mentioned, of the longitudinal line in the middle of the side is a feature which is foreign to *Arpadites*, it may on the other hand be frequently observed in *Anasirenites*. And also while the peculiar division of the external saddle in *Anasirenites Aristotelis* is absent in *Arpadites*, its presence has already been proved in *Sirenites*, which is closely related to *Anasirenites*. Thus we are led to trace back the resemblance between *Anasirenites Aristotelis* and *Arpadites Hindei* to convergent development of different stocks.

Sutures.—Unfortunately it was not possible to obtain a connected suture-line. The type of the sutures stands on the border line between brachyphyll and dolichophyll development. The saddles, which show a pyramidal outline, are of considerable height. The first lateral lobe is divided into three points.

Dimensions.—

Diameter	33 mm.
Height of the last whorl	17·5 „
Thickness „ „ „	8 „
Width of the umbilicus	3·3 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

c. CLIONITES.

1. CLIONITES WOODWARDI, E. v. Mojs., Pl. XIII, Figs. 4, 5.

I regard as the type of the species the narrower specimen illustrated in Fig. 4, whilst distinguishing the broader one, Fig. 5, as *varietas crassa*. In both cases the whorls are higher than wide and embrace one another only on the external part.

The *varietas crassa*, however, increases a little more rapidly and appears therefore somewhat more narrowly umbilicated than the typical form.

The sides are rather flat and bordered by a distinctly marked umbilical margin. The umbilical wall descends steeply to the umbilical suture. The external part is inflated. The external furrow is not excavated in the shell, but only formed by the two rows of external tubercles greatly lengthened at the base spirally. The sculpture consists of strong ribs ornamented with five rows of tubercles, and a very faint longitudinal striation.

The narrow ribs, running in a tolerably straight direction up to the marginal tubercles and then obliquely turning towards the anterior, are separated by wide intercostal spaces. Bifurcations of the ribs occur on the umbilical tubercles as well as on the marginal ones. Some ribs, however, run also undivided.

Between the marginal and the umbilical tubercles there occurs situated nearest to the marginal ones another row of lateral tubercles, which is more strongly developed on the inner whorls and becomes considerably weakened on the last, still chambered whorl. A further row of tubercles is placed on the external part in the middle, between the marginal and external tubercles. These outer rows of tubercles are strongly developed and take almost the character of elongated external spines. In the variety *crassa* some tubercles become, however, flattened in the anterior part of the last whorl and have almost the appearance of the elongated external tubercles occurring on the body-chamber of *Clionites aberrans*.

Sutures.—The second lateral lobe coincides with the umbilical tubercles. The external lobe is lower than the first lateral lobe and divided into three-pointed halves by a very low broad median projection. First lateral lobe narrow and deep, divided into three points at the base; second lateral lobe considerably shorter, three-pointed at the base like the first. In the typical form there arise from the lateral lobes, joining the denticulations of the lobes, two notches or only one at the outer saddle wall. Also in the variety *crassa* there are on the last septa notches on the wall of the external saddle which is directed towards the lateral lobe. Saddles with unbroken margin, rounded above. External saddle considerably higher than the first lateral saddle. The second, very low lateral saddle, descends on the umbilical wall to the suture.

Dimensions.—

	I.	II. *Var. crassa.*
Diameter	49 mm.	53 mm.
Height of the last whorl	17·5 „	20 „
Thickness „ „ „ „	12·5 „	18 „
Width of the umbilicus	20 „	19 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 6.

2. Clionites Salteri, E. v. Mojs., Pl. XIII, Figs. 6, 7.

This species, closely related to *Clionites Woodwardi*, is distinguished by slowly increasing whorls, which are wider than high. I consider the specimen illustrated in Fig. 6 as the type, from which the variety, Fig. 7, is distinguished by more crowded and more numerous ribs, as well as by slight differences in the structure of the sutures. The transverse sculpture agrees in the principal features with that of *Clionites Woodwardi.* It is chiefly distinguished by the oblique, backwardly directed ribs on the sides, and also by the external ribs running in a straight direction from the marginal to the external tubercles. In the typical form there occurs an early weakening of the tubercles, especially of the lateral tubercles and of the row of tubercles intercalated between the marginal and external tubercles. Spiral striation was not observed.

Sutures.—The second lateral lobe stands inside the umbilical margin already on the umbilical wall in the typical specimen, whilst in the variety, distinguished by closer ribbing, the second lateral lobe coincides with the umbilical margin. The external lobe almost attains the depth of the first lateral lobe. It is divided into two- to three-pointed halves by a small median projection without denticulations. The first lateral lobe is four-pointed. The two middle points in the typical form are considerably larger than the neighbouring lateral ones, whilst the points in the closely ribbed variety almost attain the same size. The indication of a fifth point in this variety is sometimes observable.

The second lateral lobe is two-pointed; the saddles, with unbroken margin, are somewhat higher and narrower in the type specimen, but in the variety they are lower and broader. The external saddle and the first lateral one possess, approximately, the same height. The second lateral saddle on the umbilical wall is only rudimentarily developed.

Dimensions.—

Diameter	38 mm.
Height of the last whorl	12 „
Thickness „ „ „	15
Width of the umbilicus	16 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 4.

3. Clionites aberrans, E. v. Mojs., Pl. XIII, Fig. 8.

The inner whorls agree with those of *Clionites Woodwardi* and also possess the longitudinal striation which is observed in *Clionites Woodwardi.* The outer whorl which in the present fragment belongs entirely to the body-chamber, shows a kind of sculpture considerably differing from that of the inner whorl and reminding us of the sculpture of *Protachyceras Thous,* Dtm.[1] That this is only an outward resemblance resting upon a chance assemblage of characters is shown by the entirely different modes of development of the two species, which can be observed in the inner whorls. *Clionites aberrans* agrees, as mentioned above, in the inner whorls with *Clionites Woodwardi,* whilst the inner whorls of *Protrachyceras Thous* are like the outer.

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[1] E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, Bd. II., p. 629, Taf. CLXVIII., Figs. 2—11.

The differences which the body-chamber of *Clionites aberrans* shows are as follow.—The transverse ribs appear to be slightly sigmoidally curved. They have become fold-like and striated and in some places entirely converted into striæ. Of the five spiral tubercles only the umbilical, marginal and external ones are distinctly developed, whilst the lateral row of tubercles is scarcely even indicated. The row of tubercles between the marginal and external tubercles is a little better preserved, but these tubercles only appear somewhat lengthened spirally. The most striking change is noticeable in the external tubercles which now appear as rounded keel-tubercles, greatly elongated spirally. In the description of variety *crassa* of *Clionites Woodwardi* the unique change of the normal external tubercles into such elongated tubercles has been mentioned.

A further feature of the difference in the body-chamber is the restriction of the bifurcations of the ribs to the region of the umbilical tubercles.

Sutures.—Not known in detail.

Dimensions.—The fragmentary condition of the specimen does not allow of measurements of its parts.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

4. Clionites Hughesi, E. v. Mojs., Pl. XIV, Figs. 1—3.

This type is subject to some variations which are indicated in our illustrations; such variations are best regarded as characterizing varieties of a species, as the variations observable do not appear to be sufficient to admit of their being considered as constituting special species.

The type specimen, Fig. 1, possesses slowly increasing whorls, embracing one another on the external part. The whorls are wider than high in the young, but on the body-chamber somewhat higher than wide, leaving a wide umbilicus open.

The sculpture shows the same elements as *Clionites Woodwardi* and *Clionites Salteri* and is on the inner whorls considered also to be already highly developed, as the transverse ribs appear to be finely wrought; they stand close together and five rows of spiral tubercles are present. On the last whorl, which for the greater part belongs to the body-chamber, the more widely separated numerous ribs assume a slightly sigmoidal curvature and the lateral tubercles disappear nearly completely, whilst the other rows of tubercles become also visibly weaker. The increase of the ribs occurring in the anterior part of the body-chamber takes the character of intercalations.

In proportion to the weakening of the tubercles on the external part the external furrow becomes less conspicuous. The transverse sculpture closes gradually together, traversing continuously the external part.

Where the shell is well preserved, strong inversely imbricated lines of growth, which are crossed by much more feebly indicated and obscure longitudinal lines, are to be seen.

The specimen represented in Fig. 2 is chiefly distinguished from the typical form by the less curved course of the transverse ribs on the body-chamber whorl, as also by the fact that the weaker ribs mostly reach to the umbilical margin. Sometimes these secondary ribs, corresponding to the intercalated ribs of the type form, also show faint traces of umbilical tubercles. The external sculpture occurs also in this variety only in the anterior part of the body-chamber, coming from both halves of the shell and terminating at the external tubercles, while in the foremost part of the body-chamber the ribs meet over the disappearing external furrow.

The form with the body-chamber represented in Fig. 3 might be regarded as that of an immature individual, if the obliteration of the lateral tubercles did not indicate that the mature stage had already been reached. Besides being smaller this specimen is distinguished by a slight inflation of the sides and by the almost complete obliteration of the umbilical tubercles. With reference to the ribbing it stands between the specimens represented in Figures 1 and 2. Though a weakening of the tubercles likewise occurs on the external part, no meeting of the lateral sculpture takes place across this part.

Sutures.—External lobe very deep and in line with the first lateral lobe; the two halves two-pointed. First lateral lobe four-pointed. The two middle points reach a somewhat greater depth than the lateral ones. The second lateral lobe which is two-pointed, is situated on the umbilical margin. External saddle somewhat weaker than the first lateral saddle. Both are about the same height, with an unbroken margin, and rounded above.

Dimensions.—

Diameter	44	mm.
Height of the last whorl	15	„
Thickness „ „ „	14	„
Width of the umbilicus	18	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 4.

5. Clionites, n. f. ind., P. XIV, Fig. 4.

The specimen figured, broken as it is at the beginning of the body-chamber, is closely related to *Clionites Hughesi*, with which it agrees in reference to its shape and the nature of its sculpture. It is, however, so distinct from the more closely ribbed *Clionites Hughesi* by the separation of the ribs by a greater distance on the outer whorls, especially at the beginning of the body-chamber, and the considerable thickening of the latter connected therewith, that it can no more be placed in the group of varieties of this species. If we take into consideration that on specimens with more complete body-chambers, the always strongly developed ribs must give to the species a habit which represents a mode of variation, entirely opposed to that of *Clionites Hughesi*, the independent position of the present form cannot well be doubted.

Sutures.—The suture-line shows close agreement with that of *Clionites Hughesi.* The external lobe, however, attains a greater depth than the first lateral lobe, which reaches a greater width than that of *Clionites Hughesi.* The external saddle is somewhat higher than the first lateral saddle.

Dimensions.—

Diameter	41	mm.
Height of the last whorl	13·5	„
Thickness „ „ „	12·5	„
Width of the umbilicus	17	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

6. CLIONITES SPINOSUS, E. v. Mojs., Pl. XIV, Fig. 5.

The shell, only slightly embracing, is, when compared with species occurring in the same bed, distinguished by the permanence of the tubercles which increase in strength and almost become spines. Besides the usual five rows of tubercles which distinguish the related Indian species, there occurs on the body-chamber whorl also the indication of a new intercalated sixth spiral, which appears on the sides between the umbilical and lateral tubercles already occurring on the inner whorls.

A further peculiarity of *Clionites spinosus* lies in the irregular character of the bifurcation and connection of the ribs. For instance, the connection of the ribs on the sides occurs not rarely on the marginal tubercles. The strength of the ribs is to a certain extent disproportionate to the extreme development of the spine-like tubercles.

The lines of growth are distinctly developed. They are crossed by less conspicuous longitudinal striæ. The latter are strongest on the external part of the body-chamber. The spirally elongated external tubercles unite at the base in the same manner as the external keels.

Sutures.—Not known in detail.

Dimensions.—

Diameter	31	mm.
Height of the last whorl	11·5	„
Thickness „ „ „	11	„
Width of the umbilicus	13	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

d. STEINMANNITES.

1. STEINMANNITES UNDULATOSTRIATUS, E. v. Mojs., Pl. XIII, Fig. 1.

The widely umbilicated shell consists of slowly increasing whorls, embracing one another only on the external part. They are higher than they are wide and possess a rectangular transverse section. The umbilicus as well as the external margin are sharply defined by the umbilical and marginal tubercles. The strongly developed external keels, which are accompanied by faint keel-furrows losing themselves in the anterior part of the last whorl, rise high above the truncated external part. They enclose the external furrow which is distinguished by its great width.

In the sculpture of the chambered whorls there are to be distinguished two systems apparently independent of each other, namely, (1) the transverse sculpture, and (2) the quite peculiar longitudinal striation crossing the transverse ribs, which, it must especially be pointed out, is not to be confounded with the epidermidæ, belonging as it does to the shell itself, impressing it so that the striation is visible on the cast.

The longitudinal striation, which is strongly developed on the inner whorls and gradually weakens on the outer whorls till it completely disappears, is distinguished from a normal longitudinal striation by the fact that it is arranged in undulating arches cutting the transverse sculpture not vertically but diagonally, and at certain intervals, passing from the longitudinal direction into the transverse, bending outwards towards the external margin. Thus the longitudinal striation, according to the species, is divided into a varying number of divisions, each of which has the same undulating course. A flat arch convex towards the outer side is succeeded by a larger arch concave towards the outer side, whose longer anterior portion assumes a transverse direction. These peculiar striæ do not exist at the lower part of the sides, but they begin somewhat higher, below the middle of the sides. The foremost striæ of each division, transversely directed towards the outer side, are distinguished by greater fineness and are somewhat closer. The number of divisions occurring in the circumference of the last chambered whorl amounts to five in *Steinmannites undulatostriatus*.

A very characteristic peculiarity of the transverse sculpture, which seems to stand in a certain relation with the undulato-striate longitudinal sculpture, must be emphasized and not remain unnoticed in a description of the latter. It is that the occurrence of typical marginal lunulæ coincides with the outwardly concave arches of each division. A tubercular thickening is connected with the lunulæ.[1] It is now remarkable that only one lunular tubercle occurs on each division, whilst the remaining ribs, without forming a marginal tubercle pass over on to the external side. After the disappearance of the undulating longitudinal striation the marginal lunular tubercles also cease and in their place there appear marginal tubercles regularly on all the ribs.

The very strong transverse sculpture shows ribs wide apart from one another, which at shorter or longer intervals bear strong tubercles on the umbilical margin. Two neighbouring ribs then mostly join fork-like together at these tubercles. Those ribs which carry no umbilical tubercles are more feebly developed and undergo, as a rule, no furcation. The radial course of the ribs is tolerably straight. The ribs forming an external lappet in their course only bend forward on the external part producing the tuberculation on the external keels.

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[1] Lunulæ occur especially in the *Ceratites* genus *Thisbites* (Ceph. d. Hallst. Kalke, Bd. II, p. 399) and in the Arctic group of *Ceratites geminati*, probably connected with this genus.

Faint traces of a normal longitudinal striation are present at the beginning of the body-chamber.

Sutures.—The suture-line, of ceratitic development, shows rather narrow saddles with unbroken margin, with narrow lobes denticulated at the base. The external lobe is shorter than the first lateral one and divided by a small narrow median projection rounded above. The two halves of the lobes differ slightly from each other. This is caused by the circumstance that a few feeble denticulations which arise on the wall of the saddle from the two-pointed base occur on the right external saddle. The first lateral lobe is divided into from five to six points. The second lateral lobe possesses besides two distinct points also the trace of a third point on the side of the second lateral saddle.

Of the saddles the external one is the highest. The second lateral saddle is only weakly developed. It is situated on the umbilical wall, sinking down steeply to the suture.

Dimensions.—

Diameter	70	mm.
Height of the last whorl	25·5	„
Breadth „ „ „	20·5	„
Width of the umbilicus	27·5	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

2. STEINMANNITES CLIONITOIDES, E. v. Mojs., Pl. XII., Fig. 6.

This species, unfortunately represented only by the figured fragment, gives a typical representation of an undulatostriate *Steinmannites* on the inner whorls, whilst the still chambered outer whorl tends to a resemblance with the *Clionites* type.

The outer volutions are somewhat higher than wide, but show a very slow increase in height. The penultimate whorl is still wider than it is high. The embracing is limited to the external part of the preceding whorl, which in the immature condition appears somewhat wider than in the mature state, when in consequence of the increase in height the external part shows itself to be a little more narrowly inflated. On the penultimate whorl the transverse section approaches a quadrate form with rounded angles, but on the last whorl it presents a rectangular form with preponderating height.

The sculpture consists on the inner whorls of two elements, independent of each other, *viz.*: (*a*) the transverse sculpture which continues on to the outer whorls, and (*b*) the oblique longitudinal striation which is confined to the inner whorls. As to the transverse sculpture, this agrees in general arrangement with that of the remaining species of the undulatostriate *Steinmannites*. The ribbing is moderately close. It becomes less close on the outer whorls, on which thus the width of the intercostal spaces increases. The ribs show a stronger concavity forwards on the sides of the inner whorls than on the outer whorls, on which up to the knob-like swellings, where commences the bend of the ribs, these (the ribs) turning obliquely forward on the external part, only show a slight curvature. The ribs are partly united in pairs to forked ribs, partly running undivided from the umbilical margin to the outer margin. On the outer whorl especially, the forked ribs show knot-like swellings on the umbilical margin. The single ribs show only faint indications of umbilical tubercles on the outer whorl. On the inner whorls, which are covered with oblique longitudinal striæ, distinct traces of lunulæ are to be seen, as in *Steinmannites undulatostriatus*. Secondary bifurcations of the ribs rarely occur on the knot-like swellings of the outer margin. To the rarity of such bifurcations and the wide separation of the ribs is to be attributed the great distance between the tubercles on the external keel of the outer whorl, as these tubercles are formed by the intersection of the ribs and the external keels. The closer notching of the external keels of the inner whorls is due to their closer ribbing. The obliquely running longitudinal striæ are divided within the circumference of the penultimate whorl into three parts, and the number of lunulæ within this circumference seems likewise only to be three, so that with each part only one lunula corresponds. It must further be remarked that besides the lunulæ no indications whatever of marginal tubercles on the inner whorls are present.

Sutures.—The external lobe almost reaches the depth of the first lateral lobe. It is divided into two halves by a small median projection, rounded above; and these are distinguished by three or four little points. The first lateral lobe shows four or five points, of which those lying nearest the saddles are shorter than the middle ones. The greater number is not observed in the foremost septa, which only possess four points, but further backwards. The second lateral lobe, which coincides with the umbilical margin, has two points, of which the inner is distinctly deeper than the outer, which inclines towards the first lateral saddle. The external and the lateral saddles are rather narrow, with an unbroken margin. There can scarcely be said to be a second lateral saddle, for the septum rises from the base of the second lateral lobe only to the height of the small denticulations dividing this lobe and then descends on the umbilical wall in a straight line vertical to the umbilical suture.

Dimensions.—

Diameter	45 mm.
Height of the last whorl	16·5 „
Thickness „ „ „	13·5 „
Width of the umbilicus	17·5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

3. Steinmannites Desiderii, E. v. Mojs., Pl. XII., Fig. 7.

This species, closely related to *Steinmannites Clionitoides*, is distinguished from the latter by the permanence of the notched external keels. Thus, in

Steinmannites Clionitoides, the tubercles of the external keels occurring at wide intervals attain a certain independence, so that the keels on which they are placed become less conspicuous. In *Steinmannites Desiderii*, on the other hand, the tubercles on the external keels are but faintly developed, so that the latter become the more prominent.

A further distinction between the two species under consideration lies in the closer disposition and the slighter curvature of the ribs on the last whorl. Umbilical tubercles are very distinct here, whilst the indications of knot-like marginal swellings are but very slightly developed. This is probably dependent upon the fact that the ribs become obsolete at these marginal swellings and do not continue on to the external part, as is the case on the inner whorls which are provided with lunulæ and oblique longitudinal striæ.

The oblique longitudinal striæ form three divisions on the penultimate whorl. They are remarkably strongly developed and are present on the cast as well as on the shell. The anterior fragment of the last whorl is deficient in these striæ.

Sutures.—The suture-lines also show distinguishing features between the two species in question. Thus the first lateral lobe shows a considerable differentiation of the denticles, of which the small middle one is accompanied by two much higher ones, rounded above, whilst in *Steinmannites Clionitoides* such marked differences in size do not exist. The second lateral lobe is decidedly two-pointed; and the inner point which is already situated on the umbilical margin is also here the deeper one.

In contradistinction to *Steinmannites Clionitoides* there is a distinct second lateral saddle here which is situated on the umbilical wall.

Dimensions.—

Diameter	40 mm.
Height of the last whorl	17 „
Thickness „ „ „	14·5 „
Width of the umbilicus	13 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

4. Steinmannites Noetlingi, E. v. Mojs., Pl. XII., Figs. 8-9.

In spite of the difference in size between the specimens figured, the small one represented in Fig. 9 cannot be regarded as a young, immature form. It must be considered a mature individual, as it shows on the body-chamber, occupying the anterior half of the last whorl, the same variations of sculpture as the larger form represented in Fig. 8. But as some slight differences other than that of size can also be recognised, the smaller individual may be looked upon as a variety.

The inner whorls, provided with oblique spiral striæ and lunulæ, show a great similarity to *Steinmannites Clionitoides* and *Steinmannites Desiderii*. Essential differences are only to be observed after the obliteration of the oblique longitudinal striation on the body-chamber of mature individuals. The stronger curvature of the ribs on the sides, and especially their strong backwardly directed bend up to the marginal knot-like swellings together with the absence of the umbilical tubercles form a remarkable distinction. Furthermore the ribs on the sides are rather strong, and separated from one another by wide intercostal spaces.

But the external part of the body-chamber in a full-grown shell offers much more striking peculiarities (Fig. 8c). Between the marginal knot-like swellings and the notched external keels, but nearer the latter, for example, a spiral connection is formed between the neighbouring ribs where a forked division of the ribs not seldom results, as on the larger specimen (Fig. 8), whilst in the form Fig. 9, with a smaller body-chamber, such a division has never been observed. These divisions, which result in a corresponding increase of tubercles on the external keels, cease, however, also on the larger form towards the aperture.

A further feature of *Steinmannites Noetlingi* is exhibited, moreover, by the rather faint indications of normal longitudinal striæ observable on the body-chamber after the disappearance of the oblique longitudinal striæ.

The length of the body-chamber amounts to about three-quarters of the last whorl.

Sutures.—On the smaller form, Fig. 9, the denticulations extend from the base of the lobes to the walls of the saddle, whereby more numerous denticles arise. But it must be mentioned that the finer details of the lobes in the larger specimen (Fig. 8) could not be so distinctly observed as in the smaller one on account of less favourable preservation. In one place, however, in the larger form denticles arising from the first lateral lobe to the external saddle have also been observed. The external lobe is somewhat shorter than the first lateral one which is distinguished by great width. The saddles are only moderately high and arch-like in form. The umbilical suture coincides with the first auxiliary lobe.

Dimensions.—

Diameter	46 mm.
Height of the last whorl	17 „
Thickness „ „ „	16 „
Width of the umbilicus	17 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

5. Steinmannites Lubbocki, E. v. Mojs., Pl. XIII., Figs. 2-3.

This species, which forms an independent type and does not agree with any species known up to the present time, is characterised by the extinction of the external keels in the anterior part of the body-chamber, connected with a slight depression of the tube.

The external habit of *Steinmannites Lubbocki* shows, it is true, some similarity to the forms of the group *Undulatostriati.* But it just wants the peculiar longitudinal sculpture which distinguishes this group; so that here only a remote relationship could be admitted, On the inner whorls, as seen in Fig. 2, a rapid increase, especially in height, takes place, whilst on the last whorl, provided with the body-chamber, the increase in height is slow. This retardation of the growth in height increases in a very striking manner towards the end of the body-chamber, a circumstance which may be accounted for by the disappearance of the external keels and the simultaneous rounding of the external part. The whorls embrace one another only on the external part. But as the latter is rather strongly inflated and a rapid growth of the inner whorls in height takes place, the umbilicus remains proportionally narrow.

The sides are slightly inflated, but become flattened on the body-chamber. The external keels, as such, are only feebly developed. They rise with the broad and shallow external furrow, enclosed by them, over the inflation of the external part. The keels, as already mentioned, disappear entirely on the anterior part of the body-chamber, and the transverse ribs, greatly attenuated, close together over the rounded external part without forming external tubercles.

The ribs are very crowded on the innermost whorls and are here very fine. With the growth of the whorls the ribs, increasing considerably in strength, become wider apart so that broad intercostal spaces are formed. In the anterior part of the body-chamber, towards the aperture, the ribs get finer and are again more crowded. Bifurcations of the ribs occur seldom on the sides or outside the umbilical margin, which is distinctly marked only on the last whorl, but more frequently outside the marginal tubercles, which (the tubercles) are more distinctly developed on the inner whorls and gradually become obliterated on the last whorl. Indications of umbilical tubercles are present on the last whorl. Not all the ribs form tubercles on the external keels, as neighbouring ribs connect together here and there.

The keels are bordered by faint longitudinal depressions which take the place of keel-furrows.

As to the course of the ribs it has to be mentioned that up to the marginal tubercles the ribs are bent somewhat obliquely towards the posterior part. Outside the marginal tubercles the ribs bend in the opposite direction, that is, strongly forwards.

It is worthy of note that there are several fragments of body-chambers which, considering the rarity of the latter in the types related to this genus, leads one to infer that the shell was especially strongly constructed.

Sutures.—External lobe considerably shorter than the first lateral lobe, divided into three-pointed halves by a broad median projection with a rounded, unbroken margin. The first lateral lobe is seven-pointed and the second three-pointed with a longer middle point. The last suture-lines immediately preceding the body-chamber are somewhat less richly indented, as the first lateral lobe at this place only shows five points instead of seven.

Saddles with unbroken margin, rounded. External saddle rather narrow and high, first lateral saddle broader and lower. The second lateral saddle descends over the umbilical wall to the umbilical suture. In some places slight notches, succeeding the points of the lobes, are observed at the base of the saddles.

Dimensions.—

Diameter	64 mm.
Height of the last whorl	26 „
Thickness „ „ „	24 „
Width of the umbilicus	19 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 7.

e. DIONITES.

DIONITES, ind., cf. D. ASBOLUS (A. v. Dittmar).

We have here a form (unfortunately only a fragment of a whorl) which is comparable to *Dionites Asbolus* (Mojsisovics, Ceph. d. Hallst. Kalke, II. Bd., p. 492, Taf. CLIV., Figs. 8-9), or possibly even identical with this species. The broad, flatly rounded ribs with the strongly developed lines of growth are to be seen. They are crossed by indistinct spiral lines which cause a thickening at the point of intersection.

Sutures.—Not known.

Dimensions.—Not measurable.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

II. HERACLITEA.

1. HERACLITES, E. v. Mojs.

1879. Vorläufige kurze Uebersicht der Ammoniten-Gattungen der mediterranen und juvavischen Trias. Verhandl. der k. k. geolog. Reichsanst, p. 141.

1893. Cephalopoden der Hallstätter Kalke, Bd. II, p. 503.

The position assigned to the type described under the specific name of *H. jandianus* in the genus *Heraclites* requires some words of justification.

The length of the body-chamber in *H. jandianus* is somewhat more than half of the last whorl. As the sculpture in the foremost part of the last whorl is considerably weakened and reduced to striæ, and occurs as a rule only in the closest vicinity of the margin of the mouth in mature individuals, the present specimen is probably tolerably complete, and the length of the body-chamber might not have amounted to more than half a whorl.

The habit of the shell and its sculpture agree with those of *Ceratites*, whilst the lobes are indented in a dolichophyll manner. But shells with ceratitic development having lobes with dolichophyll differentiation are assigned to the genus *Heraclites*. The present shell cannot, however, be brought into closer connection either with the group of *Heraclites robusti*, or of *Heraclites suavi-*

costati, but represents an independent and unique type, to which the subgeneric name *Guembelites* might be applied.

Guembelites are shells with widely embracing whorls with a short body-chamber, having ceratitic sculpture on the sides, truncated, and completely smooth external part and small dolichophyll lobes which comprise also several auxiliary ones.

HERACLITES (GUEMBELITES) JANDIANUS, E. v. Mojs., Pl. X, Fig. 1.

The whorls are higher than they are wide and enclose a rather narrow umbilicus as they overlap one another very considerably. The sides are inflated and reach their greatest bulging in the vicinity of the sharply defined umbilical margin. The umbilical wall descends steeply to its suture. The external part is sharply marked off from the sides by the marginal "ears" which are elongated in the direction of the spiral. It forms a flattened smooth area, by which the sculpture on the two sides is completely interrupted.

The sculpture consists of fold-like ribs which are rather strongly developed on the inner whorls and at the beginning of the last whorl, but becomes visibly weaker on the anterior half of the last whorl. Bifurcations of the ribs, which show during their course a slight concavity towards the anterior part, take place partly near the umbilical margin and partly somewhat farther outwards, but always within half the height of the whorl. Instead of the bifurcations of the ribs there also occur intercalated ribs. After the appearance of these bifurcations or intercalations, two or three short ribs of the outer region of the sides correspond with one stem-rib in the umbilical region.

Near the outer margin, or rather near the marginal "ears", there occur on the body-chamber, besides the above-mentioned multiplication of the ribs, other peculiar offshoots of them into short narrow ribs, which enter into connection with the succeeding marginal "ears." In this way the marginal "ears" may be connected with two different ribs. But, on the other hand, one rib may also be united with two different marginal "ears." The number of the latter agrees with that of the short ribs proceeding from the primary divisions of the ribs, whilst the little ribs on the outer margin are merely offshoots. This feature has unfortunately not been fully brought out in our illustration.

Towards the end of the last whorl, the larger anterior half of which belongs to the body-chamber, the sculpture on the sides becomes weak, and flat striæ-like folds appear.

Sutures.—Unfortunately the details of the sutures could not be exposed as intact and complete as is necessary for an illustration. The dolichophyll saddles and lobes are short and thus rather narrow and numerous, as there are still two auxiliary lobes outside the umbilical margin. The external lobe seems to be shorter than the first lateral. Taking into consideration the denticulation the lobes of *Heraclites Bellonii*, Mojs. (Ceph. d. Hallst. Kalke, II. Bd., Taf. CXXXIX, Fig. 10c) may be brought into comparison.

Dimensions.—

Diameter	43 mm.
Height of the last whorl	22 „
Thickness „ „ „	19 „
Width of the umbilicus	5 „

Locality and Geological Position.—From the débris on the eastern slopes of the Jandi Pass, probably from the Halorites-Limestone. Number of specimens examined, 1.

2. Tibetites, E. v. Mojs.

1893. *Tibetites*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II., p. 516.

In this genus, replacing the European genus *Cyrtopleurites* in the Indian trias, three groups or subgenera may be distinguished, *viz.* :—

(1) *Tibetites*, s. str.
(2) *Anatibetites.*
(3) *Paratibetites.*

In the subgenus *Tibetites* the shape and sculpture of the body-chamber agrees entirely with those of the chambered parts of the shell. The morphological agreement with *Cyrtopleurites*, s. str., is extraordinarily great, and only the absence of the notchings on the external "ears", so characteristic of *Cyrtopleurites*, can be regarded as a distinguishing feature of the shell. Instead of the fringed[1] external "ears" of *Cyrtopleurites*, there occur in *Tibetites* therefore non-fringed external "ears." In the young, where the external part is still rather broad and flattened and the external "ears" are still weakly developed, the shells remind us of *Heraclites Ariciæ* and like this species show a complete ceratitic habit, which disappears with increasing age in consequence of the inflation and pointed shape of the external part, as well as of the considerable growth of the external "ears."

The subgenus *Anatibetites* is morphologically distinguished from the typical *Tibetites* by the flattening of the external part occurring on the body-chamber and by the simultaneous and entire obliteration of the external "ears." In consequence of this mode of variation, there exists morphologically such a close agreement with *Heraclites* that without the knowledge of the differently developed sutures *Anatibetites* could not be separated from *Heraclites*. The latter possesses dolichophyll sutures, whilst *Anatibetites* has the same ceratitic-developed sutures with divided external saddle as *Tibetites* and *Paratibetites*. After the obliteration of the external "ears" the body-chamber of *Anatibetites* offers the perfect representation of a *Ceratites* with the umbilical tubercles wanting.

The subgenus *Paratibetites* undergoes variations of quite a different character from those of *Anatibites*. While in the young the external part, as in *Tibetites* and *Anatibetites*, is still slightly inflated, it becomes in the middle stages of growth sharpened into proper keels accompanying the median furrow which has meanwhile appeared. Simultaneously with this the closing together of the external "ears" occurs. With this variation, which corresponds with the stage reached in the European species of *Hauerites*, the tendency towards a sharpening of the external part is, however, not yet exhausted in *Paratibetites*. With the simultaneous disappearance of the external furrow the two external keels close entirely together in the course of time, and the external part appears now obtusely pointed. In a manner analogous to that of *Hauerites* the lateral sculpture changes simultaneously with the sharpening of the external part and shows a tendency to become weaker and finally to disappear. The marginal and lateral tubercles fuse together to form spiral striæ, the ribs become flattened, and the disc assumes more and more a smooth-shelled character, till finally, as in *Paratibetites Tornquisti*, the marginal and lateral striæ also disappear and only obscure fold-like indications of the transverse ribs are observable.

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[1] Gewimpert.—Transl.

The sutures of *Tibetites*, *Anatibetites* and *Paratibetites* point, in a way similar to the morphological conditions of the young stage of growth, to the near relationship or rather to the common descent of a primitive form allied to the type of *Tibetites*. *Tibetites* and *Anatibetites* show, moreover, a suture-line with typical ceratitic development which is distinguished from the sutures of *Ceratites* only by the division of the external saddle, and by the freeing of an outer denticle of the saddle caused by this. The saddles have unbroken margins; the lobes are only slightly denticulated at their base. Certain variations are shown in *Paratibetites*. The most striking change is to be observed in the external lobe which shows a tripartite arrangement. The large median projection, namely, is indented lobe-like in the middle, and in some species the marginal "wings" arise in the shape of short external saddles. In these last-mentioned forms there occurs a denticulation of the middle region of the median projection bordered by the two marginal wings, whereby this part has the appearance of a shallow external lobe divided by quite a small median projection. Further peculiarities of the *Paratibetites* sutures are—(1) the independent character of the denticles, freed from the external saddle, and (2) the brachyphyll notching ascending the walls of the saddle, which sometimes reaches to the summit and here and there strengthens into dolichophyll denticulation (*Paratibetites angustosellatus*).

The sutures of *Paratibetites* agree with those of *Hauerites*. The strongly developed median projection with the saddle-like "wings" is common to both genera. The greater independence of the outer branch of the divided external saddle is also repeated in both genera. The only distinction is the degree of denticulation in the sutures. *Hauerites* is characterised by dolichophyll, and *Paratibetites* by ceratitic and brachyphyll development of the sutures.

In spite of this close relationship I do not consider it probable that *Hauerites* is directly descended from *Paratibetites*, as the tendency of *Paratibetites* is to form an obtusely pointed external part. *Hauerites* developes from forms which agree morphologically with *Cyrtopleurites*.[1] As well might it be assumed that *Cyrtopleurites* is the direct descendant of *Tibetites*, as *Cyrtopleurites* occurs already in the Julian beds, that is in about the same horizon in which *Tibetites* appears for the first time in India. Moreover the sutures of *Cyrtopleurites* differ from the sutures in *Tibetites* farther than the sutures of *Hauerites* differ from those of the genus *Paratibetites.* The external saddle of *Cyrtopleurites,* namely, possesses two freed outer branches and the external lobe of this genus shows itself to be divided in both its halves by a larger projecting denticle.

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[1] Cephalopoden der Hallstätter Kalke, Bd. II., p. 517.

We therefore regard the degree of relationship between the European and Indian genera in question as that of a very near collateral relationship, and see in these genera representative types developed in an independent way.

Tibetites occurs for the first time in the "Daonella beds," from which a specifically indeterminable form is present. In the *Halorites* beds the two subgenera *Anatibetites* and *Paratibetites* are to be added to *Tibetites.*

a. TIBETITES, s. str.

1. Tibetites Ryalli, E.v. Mojs., Pl. XV, Figs. 3, 4.

This type shows a great morphological resemblance to the European species of *Cyrtopleurites,* as, for instance, the Julian *Cyrtopleurites Herodoti* (Ceph. der Hallst. Kalke, II Bd., p. 518, Taf. CLVIII, Fig. 10). The whorls, it is true, are higher than wide, but compared with related forms, only relatively wide; the external part is likewise rather wide and is somewhat inflated in the middle. The greatest width, however, is attained by the widely embracing whorls in the region of lateral tubercles, that is, somewhat below half of the height of the whorl. The umbilicus appears, compared with other forms, rather wide, in spite of the almost complete overlapping of the whorls.

As regards its shape there is no change in the body-chamber other than that caused chiefly by the growth of the shell. The character of the external part especially remains the same as on the chambered parts of the shell. The sculpture also on the body-chamber agrees in character with that of the chambered parts of the shell. The ribs on the sides, with only a slight sigmoidal curvature, are strongly developed and unite on the external part between the two external "ears" which arise out of them.

The ribs running in a straight direction from the deeply depressed umbilicus to the strong lateral tubercles undergo an increase outside the latter by bifurcation or intercalation, and all the ribs attain the same strength up to the outer margin, which is distinguished by strong, spirally elongated marginal tubercles. About two marginal tubercles correspond to one lateral tubercle. Only very seldom three of the former correspond to one lateral tubercle. A faintly developed spiral line connects the single lateral tubercles. The external "ears" are not "fringed,"[1] and seem to be strongly elongated in the direction of the spiral.

Tibetites Ryalli is distinguished from the similarly characterised *Paratibetites Bertrandi* by the much smaller dimensions which it reaches, but also chiefly by the persistence of the large external "ears" which remain the same on the inner whorls and on the body-chamber and undergo no changes. But these conditions could also be explained by assuming that the forms with small body-chambers are young individuals of *Paratibites Bertrandi.* This however is contradicted by the differing sculpture, not to mention the extraordinary rarity of young immature specimens. *Tibetites Ryalli* possesses a greater number of primary ribs and lateral tubercles corresponding to them. On the other hand, the number of intercalated ribs on the upper half of the sides is very small, so that, as already mentioned, two and only exceptionally three, marginal tubercles correspond, as a rule, to one lateral tubercle. It must be pointed out that the body-chamber on two specimens only could be observed, and that the third remaining one (Fig. 3, Pl. XV) shows only the beginning of the body-chamber.

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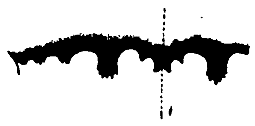
[1] Ungewimpert—Transl.

Sutures.—As regards sutures the present species approaches *Anatibetites Kelvini,* but the first lateral lobe is somewhat deeper and the outer lappet of the external saddle is only very faintly characterised, as only a very shallow-indented point produces an uneven division of the external saddle.



TIBETITES RYALLI.

Sutures from the specimen represented on Pl. XV, Fig. 3. Nat. size.

The second lateral lobe is two-pointed. The auxiliary lobes, two of which are outside the umbilical margin, only show extremely inconspicuous denticulations scarcely recognizable with the naked eye.

The external is the highest of the saddles. Beginning at the first lateral saddle the saddles appear to be wide and low, as in *Anatibetites Kelvini.*

Dimensions.—

Diameter	32 mm.
Height of the last whorl	16·5 „
Thickness „ „ „	13·5 „
Width of the umbilicus	5 „

Locality and Geological Position.—Juvavian Stage; in the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

2. TIBETITES MURCHISONI, E. v. Mojs., Pl. XV., Fig. 5.

The proportionally narrow form only possesses slightly inflated sides and a body-chamber ornamentation which agrees with that of the chambered inner casts.

There are on the sides very narrow, fine stem-ribs, separated by broad intercostal spaces, which run in a straight direction up to the small but distinctly marked lateral tubercles and assume a more fold-like character with simultaneously-occurring sigmoidal curvature outside the lateral tubercles. An intercalated rib occurs, as a rule, between two stem-ribs; the secondary rib only seldom unites with the neighbouring stem-rib and then appears as a bifurcated rib. Only two marginal tubercles correspond generally to each lateral one. In the anterior part of the body-chamber strong lines of growth as well as single striæ-like ribs are observable. A fine faint spiral line connects the lateral tubercles.

As in *Tibetites Ryalli* and in many species of *Cyrtopleurites* the longitudinally elongated external "ears" which are situated on the closely-set ribs persist up to the anterior end of the body-chamber.

Sutures.—Not known in detail.

Dimensions.—

Diameter	36	mm.
Height of the last whorl	20	„
Thickness „ „ „	11·5	„
Width of the umbilicus	3·5	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

3. TIBETITES PERRIN-SMITHI, E. v. Mojs., Pl. XV, Fig. 6.

This species is closely related to *Tibetites Murchisoni* and is chiefly distinguished by numerous flat and crowded ribs which are grouped in a variable way.

In the circumference of the last whorl comprising the body-chamber in its anterior part, there are eight stem-ribs distinguished by lateral tubercles. These ribs are distinguished by greater strength from the weaker ribs, which alternate with them with tolerable regularity. These latter bear no lateral tubercles and seem to bear a scarcely perceptible swelling where the spiral line connecting the lateral tubercles together crosses them. As the ribs provided with lateral tubercles, as also the inserted weaker ones, bifurcate outside the lateral spiral line, the number of the marginal tubercles amounts to four times that of the lateral tubercles, but, on the other hand, only to double the number in *Tibetites Murchisoni.*

Towards the aperture of the body-chamber the sculpture becomes more striæ-like and indistinct. The longitudinally elongated external "ears" persist up to the anterior end of the body-chamber.

Sutures.—Not known in detail.

Dimensions.—

Diameter	42	mm.
Height of the last whorl	23	„
Breadth „ „ „	13	„
Width of the umbilicus	4	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

4. TIBETITES, f. ind.

This is a cast of a *Tibetites*, 22 mm. in diameter, from a sandy clay of the upper Daonella beds of the Bambanag Section; it bears the characteristic sculpture and possesses external "ears" besides the lateral and marginal tubercles.

A more minute description of the cast, which is comparable with *Tibetites Ryalli* but is more finely ribbed and therefore more richly ornamented, is precluded on account of its insufficient state of preservation. But it is nevertheless interesting to establish the fact that *Tibetites* appears already in the Carnic beds. The representative genus of *Tibetites* in Europe, *viz.*, *Cyrtopleurites*, appears nearly simultaneously in the Julian Limestone of Röthelstein, near Aussee.

b. ANATIBETITES.

1. ANATIBETITES KELVINI, E. v. Mojs., Pl. XIV, Fig. 9.

1880. *Balatonites Himalayanus* (Blanford) Griesbach, Records Geol. Survey of India, Vol. XIII, p. 98.

1891. *Balatonites Himalayanus* (Blanford) Griesbach, Mem. Geol. Survey of India, Vol. XXIII, p. 142.

1892. *Heraclites*, E. v. Mojs., Vorläufige Bemerkungen über die Cephalopoden-Faunen der Himalaya-Trias. Sitzungsber. d. kais. Akad. Mathem.-naturw. Cl., Bd. CI., Abth. I., p. 374.

The figured specimen, tolerably completely preserved, may be taken as the type of the species, while the one cited by Griesbach, to which alone all the above quotations refer, belongs to a variety distinguished by a somewhat more robust sculpture. Of this variety there is only a fragment of the body-chamber present.

The high-mouthed shell consists of widely embracing whorls which are higher than wide. The umbilicus is moderately wide where the whorls are chambered, but on the body-chamber it visibly narrows, a circumstance which is to be regarded as a consequence of the considerable increase in height.

The chambered whorls present exactly the appearance of an internal cast of a *Tibetites*. The moderately inflated external part, bordered by distinct marginal angles, bears upon these two rows of strongly marked external "ears," which appear to be situated at the extremities of the ribs reaching up to them. The sides are ornamented with slightly curved ribs increasing in width outwardly. The latter begin, without tubercles, on the umbilical margin and thicken considerably below the middle of the height of the sides, simultaneously forming strong lateral tubercles, after which they undergo a bifurcation. On the outer margin the ribs thicken into strong, spirally elongated, marginal tubercles.

Before the beginning of the body-chamber, on the last, still septate portion, there occurs a weakening or rather lowering of the external "ears," which gradually, through the growing together of their bases, are converted into notched thread-like longitudinal keels. A flattening of the external area on the body-chamber, on which the thread-like longitudinal keels soon disappear, takes place simultaneously with the modification of the external "ears." The figured specimen shows, on the anterior part of the body-chamber, a slight shallow depression in the middle of the external part. The lateral sculpture likewise undergoes some modifications on the body-chamber. Bifurcations of the ribs occur rarely, but the latter are more crowded together. The strength of the lateral and marginal tubercles also decreases considerably.

The great morphological agreement with *Heraclites* which the body-chamber offers is more strikingly evident in the above-mentioned variety from Rimkin Paiar. The fragment of the body-chamber distinguished by the somewhat more robust sculpture does not lose the external sculpture so quickly as the typical specimen given. Moreover the thread-like longitudinal keels continue, though with decreasing strength, farther on the body-chamber and still show knot-like elongated swellings at the point of intersection with the greatly weakened transverse ribs. More anteriorly there appears a faint fine middle line between the thread-like longitudinal keels in the middle of the external part. The agreement with some European *Heraclites*, as, for example, with *Heraclites Bellonii* (Ceph. der Hallst. Kalke, II. Bd., p. 507, Taf. CXXXIX., Fig. 10) and *Heraclites robustus* (l. c. p. 505, Taf. CXL., Figs. 9, 10) is, through the peculiarities here described, so great that without a knowledge of the sutures there would not be the least hesitation about placing the Indian form in *Heraclites*, as I have done with the fragment of the body-chamber from Rimkin Paiar.

Sutures.—The sutures also point to the close genetic relationship with *Tibetites*, in which genus exactly the same ceratitic type of sutures, a type characterized by a division of the external saddle, is repeated. The present species is distinguished by remarkably shallow lobes, finely and regularly denticulated at the base, and low broad saddles. The denticle, separated from the external saddle by an indentation, is proportionally small and narrow. The external lobe is lower than the first lateral lobe, divided by a trapeze-like median projection. Indications of two slight projections are noticeable in both the halves of the lobes. First lateral lobe broad, with about six or seven slight serrations at its base. The second lateral lobe and the succeeding three auxiliary lobes up to the umbilical margin show a very slight gradually decreasing serration.

The broad low saddles are like right angles in which the angles have become blunt and rounded. The external saddle is somewhat lower than the first lateral saddle. It must be mentioned that the character of the sutures, of course putting aside the denticle freed from the external saddle, reminds us greatly of the type of sutures of the *Ceratites* of the German Muschelkalk.

Dimensions.—

Diameter	54 mm.
Height of the last whorl	31 „
Thickness „ „ „	20 „
Width of the umbilicus	3 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3; from Rimkin Paiar, 1.

2. ANATIBETITES, nov. f. ind.

The fragment of a body-chamber, which is broken off at the last septum, reminds us through its similarly robust sculpture as well as by its shape, of the large variety of *Heraclites robustus* (Ceph. der Hallst. Kalke, II Bd., p. 505, Taf. CXXXVIII), but is considerably narrower and must have also possessed a much narrower umbilicus.

The flattened external part shows a median longitudinal line on the cast.

Locality and Geological Position.—In the Halorites-Limestone of the Bambanag Section.

c. PARATIBETITES.

1. PARATIBETITES BERTRANDI, E. v. Mojs., Pl. XV, Fig. 1.

This shell, distinguished by a very strong sculpture, consists of widely embracing whorls which are higher than wide and enclose a narrow umbilicus. The external part is slightly inflated at the beginning of the last, still chambered whorl, but rises crest-like with the middle part bordered by the external "ears" towards the end of this whorl. The sides are inflated and reach the maximum of inflation at the strong lateral tubercles.

The sculpture consists in the lower part of the sides of undivided chief ribs running in a straight direction to the lateral tubercles. There are on the whole only nine of these ribs, in the circumference of the last whorl. These chief ribs are divided outside the lateral tubercles regularly into two ribs which do not again bifurcate. They run up to the external part with a slight concavity directed forwards and bear spirally elongated marginal tubercles on the outer margin and narrow elongated external "ears" on the external part. These latter border the middle region of the external part on both sides, this region being traversed by transverse ribs. Besides the above-mentioned chief ribs, characterized by lateral tubercles, there are also intercalated ribs present which may in some places be traced to a distance below the spiral formed by the lateral tubercles, but they mostly disappear outside this spiral. In the interspace formed by two succeeding pairs of bifurcating ribs proceeding from the lateral tubercles there is, as a rule, only one intercalated rib present. Two intercalated ribs are, however, sometimes observed. Three marginal tubercles correspond therefore to one lateral tubercle, and only in rare cases four marginal tubercles to one lateral tubercle. The intercalated ribs have already attained the strength of the bifurcated ribs on the outer margin, and they are likewise provided with marginal tubercles and external "ears."

The height of the external "ears" in the anterior part of the last whorl (chambered throughout) decreases in the same degree as the middle of the external part begins to rise like a crest. The external part now rises steeply roof-like towards the narrow flattened crest, which is bordered by the external "ears" (only slightly indicated) nearly fusing with one another.

It is to be presumed that in consequence of the continuous heightening and narrowing, the external part might on the body-chamber have been perfectly pointed, somewhat as in *Paratibetites Adolphi* and *Paratibetites Tornquisti*.

Sutures.—The median projection, having an unbroken margin, is divided in the middle by a deep indentation into two lappets. The lappets thus formed are rounded above. The two halves of the external lobe are one-pointed; they do not reach the depth of the first lateral lobe which seems to be divided at its base into two points by a larger projecting denticle. The second lateral lobe possesses two larger denticles, the first auxiliary lobe again only one, distinguished by greater dimensions. Up to the umbilical margin four denticulated auxiliary lobes may be counted.

An outer lappet is freed from the external saddle by a deep indentation, so that the external saddle appears bipartite. The outer lappet is narrower and somewhat lower than the inner part—the chief part—of the external saddle. In the deep part into which the dividing point descends there is a small denticle to be seen on the outer side of the outer lappet. The outer wall of the saddle of the chief part also shows faint traces of serrations. Three small denticles arise from the first lateral lobe on the walls of the two neighbouring saddles. In the second lateral lobe there are only two such small denticles at the base of the saddles. All the saddles are rounded above with an unbroken margin. The greatest height is reached by the narrow first lateral saddle.

Dimensions.—

Diameter	59 mm.
Height of the last whorl	34 „
Breadth „ „ „	23 „
Width of the umbilicus	5·5 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

2. Paratibetites Geikiei, E. v. Mojs., Pl. XV, Fig. 2.

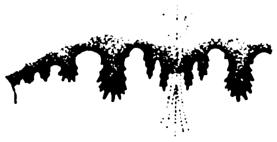
This type which might be taken for a more closely-ribbed variety of *Paratibetites Bertrandi* is distinguished by a series of modifications in the sculpture and sutures whereby the validity of the species seems to be sufficiently established.

The finer and closer lateral sculpture may be mentioned first. In the circumference of the last chambered whorl there are fourteen lateral tubercles, to which double the number of marginal tubercles correspond, for here, in contrast to *Paratibetites Bertrandi*, only two bifurcated ribs reaching the outer margin fall to one chief rib. These bifurcated ribs, which may also assume the character of intercalated ribs, curve between the lateral and marginal tubercles with a concavity directed forwards and bend on the external part obliquely towards the anterior. On the inner whorls and at the beginning of the last whorl preserved, which belongs entirely to the body-chamber, there are distinctly characterized longitudinally elongated external "ears" situated upon the ribs. But the "ears" are very soon changed on this last whorl into true external keels by fusion. They enclose a middle furrow. Undulations of the keels now take the place of the external "ears;" but not every rib corresponds to one of the undulations, the number of which is somewhat less than that of the ribs.

More anteriorly the external furrow seems to flatten and to assume a shape similar to that of *Paratibetites Bertrandi*, but the defective preservation in this region does not admit of a sufficiently reliable observation.

The stage of growth in which there is a middle furrow accompanied by external keels, is not present in *Tibetites Bertrandi*.

Sutures.—The sutures also present differences compared to *Paratibetites Bertrandi*.



Paratibetites Geikiei.

Sutures from the specimen figured on Pl. XV, Fig. 2. Nat. size.

The small size of the outer lappet freed from the external saddle may first be mentioned. This is so small and low that it could be considered as a large denticle dividing the two halves of the external lobe, the more so as the point which separates it from the external saddle shows an indication of a serration such as occurs in lobes produced by a small "tooth" projecting in the middle.

Further distinctions are presented by the brachyphyll notchings which reach the summit of the first two chief saddles on the walls turned towards the first lateral lobe.

Dimensions.—

Diameter	49	mm.
Height of the last whorl	26·5	„
Thickness „ „ „	18	„
Width of the umbilicus	5	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 5.

8. PARATIBETITES ADOLPHI, E. v. Mojs., Pl. XV, Figs. 7-10.

The large specimen of a body-chamber illustrated in Fig. 7 is to be regarded as the type of the species, to which the chambered form, Fig. 8, also belongs. The Figures 9 and 10 represent variations.

This species is not only subject to a not inconsiderable individual variability but also to rather strong ontogenetic modifications occurring in the course of the last whorls. The innermost whorls agree in respect of their sculpture and shape completely with a typical *Tibetites* provided with external "ears." From this stage of development *Paratibetites Adolphi* passes into the stage characterized by an external furrow with accompanying undulated keels. The external part assumes the shape of a slightly truncated blade with increasing sharpness and narrowing; this being accompanied by a gradual weakening of the lateral sculpture. The external keels have become completely obliterated, and the marginal tubercles, on the other hand, converted into a continuously running spiral line. The ribs on the sides are greatly weakened and have become falciform folds ending at the marginal striæ. The lateral tubercles persist, more or less weakened, to the mouth of the body-chamber. The folds on the body-chamber are most strongly developed outside the lateral tubercles.

The increase of the ribs results from bifurcation or intercalation outside the lateral tubercles. It is indicated by the proportion of the marginal tubercles to the lateral ones, two to three marginal tubercles going to one lateral tubercle. Indications of feeble fine folds occur on the body-chamber in the wide interspaces between two stronger folds. The lateral tubercles are also connected by a faintly indicated spiral line.

The variety illustrated in Fig. 9 is distinguished by closer ribbing and modifications in the course of the suture-line. The specimen, Fig. 10, represents a small variety which has already attained the features of maturity while still of small dimensions.

Sutures.—The suture-line stands in a transition stage from the ceratitic to the brachyphyll development and therefore approaches the type of sutures of *Hauerites*. In some elements of the sutures, especially on the inner wall of the external saddle and on the walls of the median elevation, the denticulation has ascended from the base of the lobes to the summit of the saddle. The median projection is of very considerable height and is divided in the middle by an indentation into two lappets. The two halves of the external lobe are, as a rule, three-pointed, with a longer middle point. The first lateral lobe, which is at the same time the deepest, is distinguished by great breadth; it is rather regularly denticulated at its base, whilst the denticles ascending on the walls of the saddles are considerably smaller. The number of auxiliary lobes situated outside the umbilical margin amounts to three. Of the saddles, the lateral one is distinguished by its characteristic shape. In *Paratibetites Adolphi*, for example, the outer lappet is as wide as, or even somewhat wider than, the true external saddle, so that the latter appears as a double saddle divided by a deeply cut indentation. In the variety illustrated in Fig. 9 this indentation almost assumes the character of an adventitious lobe on account of its greater width.

The variety just mentioned is also distinguished by more extensive denticulation of the saddles and by the greater breadth of the latter, as well as by the two-pointed division of the first auxiliary lobe, which shows a remarkably large median denticle.

Dimensions.—

Diameter	60 mm.
Height of the last whorl	35 „
Thickness „ „ „	17·5 „
Width of the umbilicus	4 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 10.

4. Paratibetites angustosellatus, E. v. Mojs., Pl. XVI, Figs. 1-4.

Of this species there are only chambered specimens in which, on the anterior fractured edge, the external furrow sunk between feeble longitudinal keels is still present. But as this furrow, as could be proved from several specimens, visibly weakens in the direction of the body-chamber, it is to be supposed that, as in the closely related *Paratibetites Adolphi*, the furrow becomes entirely obliterated on the body-chamber and the external part assumes the form of a truncated blade.

In the typical forms, Figs. 1-2, the reduction of the lateral sculpture to the dimensions of weak folds and the obliteration of the three series of spiral tubercles occur already very early. The disappearance of the lateral tubercles and their replacement by a spiral line form an essential distinction in contrast to *Paratibetites Adolphi.* The early conversion of the marginal tubercles into a marginal spiral ridge, which in the present species occurs already on the chambered whorls but in *Paratibetites Adolphi* only on the body-chamber, is likewise very remarkable.

I consider the fragment illustrated in Fig. 3 as a variety characterized by a more robust scuplture and a later beginning of the latter. In this form also the lateral tubercles decrease remarkably in size in the vicinity of the anterior margin.

Sutures.—The suture-line offers a very good basis for the characterization of the present species; the external saddle and the median projection of the external lobe especially exhibit the peculiarities.

By the fact that from the wide depression in the middle of the large median projection another small elevation arises which entirely resembles a low small median projection, the lateral lappets almost acquire the appearance of independent external saddles, somewhat comparable to the external saddles of the groups of the genus *Ptychites*, which are provided with a short external lobe.

The outer lappet, separated from the external saddle, is, in striking contrast to that of *Paratibetites Adolphi*, so extraordinarily slender and low that it does not give the impression so much of an independent saddle as of an accessory denticle of the external saddle.

The serration of the suture-line progresses still further than in *Paratibetites Adolphi*. It almost assumes the character of a dolichophyll serration on the inner wall of the external saddle (Fig. 4).

There are three auxiliary lobes outside the umbilical margin.

Dimensions.—

Diameter	51 mm.
Height of the last whorl	31 „
Thickness „ „ „	12 „
Width of the umbilicus	3 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 8.

5. Paratibetites Tornquisti, E. v. Mojs., Pl. XVI, Fig. 5.

The inner whorls of this species may be considered to agree almost entirely with those of *Paratibetites angustosellatus,* and I should perhaps have had no hesitation in regarding the present specimens of the species just named as the young stages of growth of *Paratibetites Tornquisti,* if the different structure of the sutures had not made the separation necessary.

The specimen figured shows a disc chambered throughout and culminating in a blunt blade externally. This disc gives the impression of an Ammonite of the division of the *Leiostraca* by its high-mouthed almost smooth shell. The external part is already bluntly pointed at the beginning of the last whorl. The position of the marginal tubercles is still marked by a marginal spiral ridge, but this spiral is entirely obliterated in the further course of the last whorl. Lateral tubercles are not present, or are only indicated. The lateral sculpture is confined to feeble indications of sigmoidal folds which terminate on the marginal spiral ridge. The small remnants of the shell which have been preserved from the region of the umbilicus of one half show strong lines of growth.

Sutures.—This specimen, which shows the duplication of the suture-line in an excellent way, only possesses rounded summits of the saddles with unbroken margin in spite of its considerable size.

The strongly developed median projection, the outer lappets of which ascend nearly to the height of the outer half of the external saddle shows, in the middle depressed region, three denticles separated by shallow indentations, of which the central one again takes the position of a median projection.

The external saddle is divided into two unequal halves, the inner one of which is wider and higher than the outer one. Both halves are denticulated in the brachyphyll manner on the walls turned towards the deeply cut indentation. The two halves of the external lobe, as well as the indentation dividing the external addle, run together into one point at their base.

The first lateral lobe is four-pointed at the base. Other denticles ascend the walls of the saddles but without reaching their summits. The second lateral lobe and the auxiliary lobes, four of which occur outside of the umbilical margin, are wide and beset with many teeth of approximately equal size at their base. The auxiliary saddles are broad and low.

Dimensions.—

Diameter	130	mm.
Height of the last whorl	76	„
Thickness „ „ „	33	„
Width of the umbilicus	5	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

3. HAUERITES, E. v. Mojs., Vergl. Cephalopoden der Hallstätter Kalke, Bd. II, p. 527.

HAUERITES (?) nov. f. ind., Pl. XVI, Fig. 6.

The sutures illustrated are taken from a fragment of a chambered whorl with a bluntly-pointed external part. Supposing the fragment to be complete, one should obtain a disc similar to that of *Paratibetites Tornquisti,* distinguished, however, by a somewhat greater breadth of the whorls. Whether it is correct to assign it to the genus *Hauerites,* as yet recognised with certainty only in Europe, must remain doubtful, specially as the tapering of the external part to a blunt blade without a furrow has not yet been observed in *Hauerites.*

The character of the suture-line does not, on the other hand, admit of any doubt that we have to deal with a species only distinguished from *Paratibetites* by the dolichophyll development of the sutures. *Paratibetites* agrees, apart from the tapering of the external part occurring on the outer whorls, with *Hauerites* in the most essential features and differs only in the gradual development of the sutures which is ceratitic-brachyphyll, whilst *Hauerites* has already reached the dolichophyll stage. As it does not, from the analogy of *Paratibetites,* seem impossible that a bluntly tapering external part might by a fusion of the two external keels have arisen in *Hauerites* as well as in a subgenus closely related to it, we have placed the present fragment for the time being in *Hauerites,* emphasizing however the uncertainty existing in the case.

Sutures.—The closest agreement with *Paratibetites* exists, as already mentioned, in the arrangement of the sutural elements, and especially *Paratibetites angustosellatus* shows the entirely identical arrangement of the median projection which is indented in the middle like a lobe and flanked by large saddle-like lappets.

In the lobe-like indentation of the median projection there arises a very broad central body, again comparable to a median projection, and provided with five little summits bluntly rounded above and with four rounded points between them. The central body is separated from the saddle-like lappets on both sides by a deeper indentation. The resemblance of these high lappets, provided with notches, to the external saddles of *Ptychites* is very striking. The outer branch of the saddle, freed from the true external saddle, is characterized by the lobe-like form of the indentation separating them in the manner of an adventitious saddle.

The main stem of the external saddle is divided by the freeing of a larger upper lateral branch, whereby the culminating stem becomes very narrow. The notches are throughout dolichophyll. The two lateral saddles have suffered through weathering and they appear for this reason simpler in our illustration than would be the case in uninjured specimens. The auxiliary lobes are not preserved. As to the chief lobes, the two halves of the external lobe appear two-pointed through a small elevated denticle, whilst the first lateral lobe fuses into one deep point.

Dimensions.—Not measurable.

Locality and Geological Position.—Juvavian Stage; in black limestone of the group of beds, No. 6, of the Bambanag Section. Number of specimens examined, 1.

b. TIROLITIDÆ.

1. TRACHYCERATEA.

The family of the Tirolitidæ is represented in the Indian trias only by trachyceratea which, however, do not play any important part and appear like elements of a foreign fauna within the Ceratitoidea, well represented by the Dinaritidæ.

1. TRACHYCERAS, LAUBE.[1]

a. PROTRACHYCERAS.

GROUP OF PROTRACHYCERATA VALIDA.

PROTRACHYCERAS RALPHUANUM, E. v. Mojs., Pl. XVII, Fig. 6.

This fragment, chambered throughout, belongs to a narrow rather high-mouthed form from the group of *Protrachycerata valida*, in which it reminds us by the character of its sculpture mostly of *Protrachyceras Aeoli* from the Julian Hallstatt Limestone (Ceph. der Hallst. Kalke, II Bd., p. 639, Taf. CLXXI, Fig. 1). Also *Protrachyceras longobardicum*, from the Longobardian Stage (Ceph. der medit. Trias-provinz, p. 126, Taf. XVIII, Figs. 4, 5; Taf. XX, Fig. 1; Taf. XXII, Fig. 5) shows a considerable resemblance in its shape and in the corresponding number of spiral tubercles. There is nevertheless no complete agreement with any of these forms, so that we may well consider the present form as a new species.

In striking contrast to the feebly developed broad ribs separated by wide intercostal furrows stands the strong development of the spiral tubercles, of which there are altogether eight rows. The strength of the tubercles in *Protrachyceras Aeoli* also surpasses that of the feebly developed widely separated ribs, and the one essential distinction which exists is that the interspace between the oblique spirally-elongated external "ears" and the marginal tubercles in *Protrachyceras ralphuanum* is much less than that in *Protrachyceras Aeoli*. The ribs of *Protrachyceras ralphuanum* also show a somewhat stronger bending on the sides.

Sutures.—Not known in detail.

Dimensions.—Not measurable.

Locality and Geological Position.—Carnic Stage; in blackish-grey limestone from the rocky cliffs facing the Ralphu Glacier, on the left bank of the Lissar River. Number of specimens examined, 1.

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[1] Cephalopoden der Hallstätter Kalke, Bd. II, p. 617.

b. TRACHYCERAS, s. str.

TRACHYCERAS, n. f. ind., Pl. XI, Fig. 9.

This undeterminable fragment, probably representing a new species, was only figured in order to show that, contrary to the Tuvalic Tropites beds of the Mediterranean Province, and in harmony with the reports of Perrin Smith on the Tropites Limestone of California, representatives of the genus *Trachyceras* are present in the Tropites Limestone of the Himálaya.

Though the external part could not be exposed it seems, from the experience gained in the study of European material, scarcely doubtful that we have to deal here with a *Trachyceras*. The lateral sculpture shows the characteristic habit of the true Trachycerata. The great number of spiral tubercles, the kind of development of the feebler series of tubercles, that is, appearing on the ribs and spirally weakening anteriorly, the character of the umbilical tubercles, the nature of the curvature and division of the strong ribs, which are separated by deep intercostal furrows, are all in complete harmony with such a supposition. One might even be tempted to express the opinion that the present fragment might belong to a species from the group of *Trachycerata margaritosa*. A decided opinion cannot, however, be given at present.

The slight width of the umbilicus or the considerable involution would be in accordance with the knowledge of the fact that the geologically younger members of a stock or a series of forms are very frequently much more involute than those which are geologically older. For on the supposition that the Tropites Limestone of the Himálaya as well as the Alpine Tropites Limestone are of Tuvalic age, the species represented by the present fragment would belong to the geologically youngest representative of its kind.

Sutures.—Not known.

Dimensions.—Not measurable.

Locality and Geological Position.—Carnic Stage; in the Tropites Limestone of Kalapani, in the Valley of the Kali River. Number of specimens examined, 1.

GROUP OF TRACHYCERATA DUPLICA.

TRACHYCERAS TIBETICUM, E. v. Mojs., Pl. XVII, Fig. 7.

Cf. *Trachyceras Austriacum*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II, p. 677, Taf. CLXXXII, Fig. 8; Taf. CLXXXIII, Figs. 3, 5-9; Taf. CLXXXIV, Figs. 1-3; Taf. CLXXXV, Fig. 1.

The specimen illustrated, *viz.*, a cast with the beginning of the body-chamber, agrees in its general features with *Trachyceras Austriacum* from the Feuerkogel near Aussee in such a remarkable way that I should not have hesitated to identify it with this characteristic species[1] but for the fact that the more simple structure of the suture-line required the isolation of the Indian form. I therefore regard this latter as the representative of *Trachyceras austriacum* and designate it *Trachyceras tibeticum.* Should the differentiation of the species not be considered justified —which in this, as in so many other cases, is only a matter of individual conception or personal judgment—the varietal name, *var. tibetica,* should be added to the Indian form of *Trachyceras austriacum.*

In contrast to the illustrations of the shells of *Trachyceras austriacum,* our illustration of *Trachyceras tibeticum* shows this difference that, instead of the external double row of tubercles occurring in *Trachyceras austriacum,* only knot-like extremities of the ribs are to be seen in *Trachyceras tibeticum.* This is owing to the fact that the present specimen of *Trachyceras tibeticum* is a cast on which knot-like projections of the extremities of the ribs are shown, instead of the external spiral rows of tubercles, as mentioned in the above-cited description of the species, *viz.*, *Trachyceras austriacum.* A specially strong development of the projections of the extremities of the ribs is, however, reached in the Indian cast. The swellings of the extremities of the ribs are separated from the laterally situated spiral tubercles by spiral depressions. Taking the rows of the external tubercles in the shells as two in number, the total number of the spiral tubercles occurring in one half of a whorl amounts to 15.

Sutures.—Compared with *Trachyceras austriacum* the saddles show a less deep denticulation of their stems. The first lateral lobe fuses into a narrow point, whilst in *Trachyceras austriacum* this lobe is wider and appears tripartite.

Dimensions.—

Diameter	49	mm.
Height of the last whorl	23	„
Thickness „ „ „ „	20·5	„
Width of the umbilicus	12	„

Locality and Geological Position.—Carnic Stage; in the Crinoidal Limestone of Rimkin Paiar. Number of specimens examined, 1.

2. SANDLINGITES, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II. p. 706.

1. Sandlingites Nicolai, E. v. Mojs., Pl. XVII, Figs. 1, 2.

The slowly increasing whorls are almost as high as wide and embrace one another only on the widely inflated external part, up to the marginal tubercles, which are thus visible in the widely opened umbilicus to the spiral of involution.

The sculpture consists of sharp-edged narrow transverse ribs separated by wide intercostal furrows and mostly running undivided over the sides to the external part, where they terminate on the inner whorls with feeble spine-like tubercles before they reach the smooth median band, while on the body-chamber they close gradually more distinctly together from both sides, whereby the external tubercles decrease in strength at the same time.

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[1] In the preliminary list of fossils supplied to Dr. Diener for his geological memoir this form was quoted as *Trachyceras* cf. *Austriacum*.

The ribs are somewhat more strongly developed in the lower part of the sides and run here in a strictly radial direction up to the angular elevation, from which point the ribs becoming somewhat weaker describe a slight concavity directed anteriorly up to the marginal tubercles. From the marginal tubercles the ribs run tolerably straight up to the external tubercles. If one observes the surface of the ribs on the cast closely, their edge appears as if formed of sharp apertural margins which, in some places near the umbilical margin on the above-mentioned stronger parts of the ribs, show crescents whose concavity is directed forwards. The bifurcation or intercalation of the secondary ribs which has been asserted not to occur often, takes place outside the above-mentioned angular elevation of the stem ribs. Where the shell is preserved the surface of the ribs appears less sharp-edged and even slighter.

In the illustration (Fig. 2) of the external part the bifurcations of the ribs occur somewhat more frequently.

Sutures.—The suture-line shows a close agreement with that of *Sandlingites Archibaldi*; it ascends in a similar way to the extremely shallow second lateral lobe and has an unbroken margin, with the exception of the two points of the external lobe and the feebly indicated serration of the first lateral lobe. The external saddle is considerably lower than the lateral one. The second lateral lobe is on the umbilical margin.

Dimensions.—

Diameter	28 mm.
Height of the last whorl	6·5 ,,
Thickness ,, ,, ,,	6 ,,
Width of the umbilicus	14 ,,

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

2. SANDLINGITES ARCHIBALDI, E. v. Mojs., Pl. XVII, Figs. 3—5.

This species which is easily distinguished from *Sandlingites Nicolai* by its numerous crowded transverse ribs, lacks the stronger accentuation of the stem ribs, the angular elevations on them before the beginning of the bifurcation of the ribs and their backward curvature. Where the shell is preserved (*e.g.*, inner whorls of Fig. 4) the ribs, slightly bent on the sides, are somewhat rounded; where the shell is wanting the ribs appear more sharply edged, as in Figs. 3 and 5, and separated by wider intercostal furrows. Bifurcations of the ribs are not infrequent and occur at varying heights, mostly on the sides, but sometimes also near the umbilical margin. The marginal and external tubercles are sharply marked on the chambered parts of the shell.

The sculpture is interrupted on the inner whorls in the middle of the external part but closes here in most specimens on the chambered parts, in which case, however, the external tubercles become fainter or disappear entirely. The sculpture assumes an irregular and somewhat obscure character on the body-chamber and the marginal tubercles become obliterated. The present species shows some resemblance to the European *Sandlingites Reyeri* (Ceph. der Hallst. Kalke, II. Bd., p. 713, Taf. CLXVII., Fig. 3), from which it is distinguished by the lower whorls and the feebler curvature of the ribs on the sides.

Sutures.—The external lobe is divided into two points by a small bluntly-pointed median projection and is deeper than the first lateral lobe. The latter is slightly serrated, whilst the strikingly low second lateral lobe, succeeding the high lateral saddle, is not serrated. The internal lobe is of moderate depth and width and appears at its base rounded and not serrated. The saddles have an unbroken margin. The external saddle must be considered low in comparison with the lateral saddle, ascending high from the first lateral lobe.

Dimensions.—

Diameter	40	mm.
Height of the last whorl	10	„
Thickness „ „ „	8·8	„
Width of the umbilicus	21·5	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 11.

3. SIRENITES, E. v. Mojs., Cf. Cephalopoden der Hallstätter Kalke, Bd. II., p. 725.

Group of SIRENITES ARGONAUTÆ.

1. Sirenites elegans, E. v. Mojs., Pl. XVII, Figs. 8, 9.

This narrow high-mouthed shell is narrowly umbilicated and shows a rapid growth in height. The sides are feebly inflated and converge towards the narrow external part which is formed by the two keels enclosing a deep external furrow. Towards the narrow umbilicus the shell slopes gently (without any intervening sharply marked umbilical margin characterized by stronger tubercles) towards the umbilical suture.

The transverse sculpture on the penultimate whorl of the fragment illustrated in Fig. 9 predominates, in reference to its strength, over the longitudinal sculpture represented by the series of tubercles, and the sigmoidally curved ribs become weaker only below the middle of the sides where two to three rows of spirally elongated tubercles are more conspicuous. This lateral sculpture reminds us forcibly of that of *Protrachyceras Hadwigæ* (Ceph. der Hallst. Kalke, II. Bd., p. 624, Taf. CLXVI, Figs. 4, 5) and of *Anasirenites Ekkehardi* (Ceph. der Hallst. Kalke, II. Bd., p. 773, Taf. CLIX, Figs. 5, 6). True external keels are not present in the posterior half of the penultimate whorl, the only part available for examination. The ribs terminate with obliquely placed external tubercles, and irregularly alternating bifurcations, characteristic of *Sirenites*, occur immediately before the external tubercles, so that two tubercles correspond to one rib. Between these there are ribs with only one external tubercle. Many *Sirenites* show this feature either in the more youthful stage of growth, or also in the adult condition. We have observed forms of the last category as transition forms between the *Protrachyceras*-stage and the stage of *Sirenites*.

On the outer chambered whorls illustrated in Figs. 8 and 9, crenulated external keels have taken the place of the external tubercles and the transverse ribbing of the lateral sculpture becomes less prominent compared with the longitudinally arranged series of tubercles, of which from 10 to 13 may be counted. The ribs have on the sides a strong concavity towards the anterior succeeded by a not inconsiderable backward curvature on the outer part of the sides. The last part of the ribs, again curving forward, becomes more conspicuous and individually stronger or weaker according to the strength of the development. The tubercles show a less rounded outline. There are two tubercles on the above-mentioned more strongly-marked portions of the ribs. The single series of the tubercles are of unequal strength and succeed one another at unequal distances. *Sirenites elegans* shows a great resemblance to *Sirenites Stachei* (Ceph. der Hallst. Kalke, II. Bd., p. 770, Taf. CLVII, Fig. 8), from which it is, however, distinguished by the different arrangement of the more strongly marked portions of the ribs, as well as by the modifications in the sutures.

Sutures.—The external lobe is shallower than the first lateral lobe and is divided in each of its halves into two points by a narrow denticle. The two lateral lobes, the first of which reaches the greatest depth of any of the lobes, end in one point. About four small auxiliary lobes succeed these and reach the umbilical margin. The external saddle is distinguished by strong development and considerable height. It is divided into two halves by a deeply penetrating secondary lobe, of which the outer half, nearest to the external lobe, is the narrower and lower one. The denticulation has reached the leptophyll stage.

In striking disproportion to the height of the external saddle is the insignificant elevation of the first lateral saddle and of the other saddles following in regular gradation of size. The auxiliary lobes appear as narrow denticles.

Dimensions.—These are not measurable on account of the fragmentary state of the specimens.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

2. SIRENITES RICHTERI, E. v. Mojs., Pl. XVII, Fig. 10.

This species is very closely related to *Sirenites Evæ* from the Lacic Limestone of the Leislingwand (Ceph. der Hallst. Kalke, II. Bd., p. 769, Taf. CLVI, Figs. 8, 9) and is distinguished only by the greater number of spiral tubercles and the stronger development of the sculpture. While *Sirenites Evæ* possesses rather crowded transverse ribs and, apart from the crenulated external keels, only seven spiral rows of tubercles, *Sirenites Richteri* is distinguished by more distant and less numerous transverse ribs and the presence of ten spiral rows of tubercles. These rows of tubercles are of unequal strength and succeed one another at irregular distances. The marginally placed row of tubercles shows an elongation in the direction of the ribs, whereas in the other tubercles the tendency to a spiral elongation is more or less visible. The weaker intercalated rows of tubercles especially show this elongation. The ribs are only slightly curved and may bifurcate at varying heights.

Sutures.—Not known in detail.

Dimensions.—Not measurable.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

ISOLATED TYPE.

SIRENITES, n. f. ind.

For the sake of completeness mention must be made here of a high-mouthed narrowly umbilicated *Sirenites*, which in the young may be compared with *Sirenites*, ind., illustrated on Pl. CLVII, Fig. 2, of the second volume of the "Cephalopoden der Hallstätter Kalke," from the Julian beds; but at a diameter of 40 mm. its lateral sculpture changes already in such a manner that from this point, on the chambered parts of the shell, it shows an undulation of falciform fine ribs in the middle of the sides similar to that of *Daphnites Zitteli* (Ceph. der Hallst. Kalke, II. Bd., p. 488, Taf. CLIX, Fig. 2).

The ribs which in the above-mentioned young stage are rounded become at the beginning of the full-grown stage flattened and completely smooth, whereby the intercostal furrows are reduced to sharp narrow incisions. But the fine numerous ribs soon become rounded again. A fragment of the body-chamber shows bundles of ribs near the umbilical margin similar to those of *Daphnites Zitteli.* Divisions of the ribs occur below the middle of the sides and on the outer margin.

Sutures.—These have a dolichophyll development. A more exact characterisation is not possible on account of the defective preservation of the shell.

Dimensions.—Not measurable.

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 3.

AMMONEA LEIOSTRACA.

A. ARCESTOIDEA.

a. ARCESTIDÆ.

1. ARCESTES, SUESS, Cf. *Arcestes*, E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. II., p. 785.

I feel myself compelled to add to the four sub-genera *Proarcestes*, *Pararcestes*, *Arcestes*, s. str., and *Ptycharcestes* differentiated in the work above quoted, a fifth, *viz.*, *Stenarcestes*, which will comprise the group of *Subumbilicati*, up to the present referred to *Proarcestes* (Comptes rendus de l'Académie des Sciences, Paris, 18 November, 1895). The group of *Subumbilicati* occurring simultaneously with the true *Arcestes* shares the peculiarity with *Proarcestes*, *viz.*, that the last whorl, occupied by the body-chamber, retains the character of the inner chambered whorls. But as I have already mentioned in the description of the features of the group (Ceph. d. Hallst. Kalke, I. Bd., p. 142) there occurs, as a rule, a callus closing the umbilicus which in spite of this appears depressed, a feature foreign to *Proarcestes*.

The chief reason for regarding the group of *Subumbilicati* as an independent sub-genus is, however, offered by the sutures. They resemble, as already mentioned above, the sutures of the groups *Galeati* and *Intuslabiati* belonging to *Arcestes*, s. str., but they are distinguished by the bluntly pyramidal shape of the saddles wide apart at their base. The leptophyll denticulation of the saddles does not therefore reach to the base of the saddles, but is confined to their upper half. The extensive interlocking of the neighbouring septa is facilitated by the great width of the base of the saddles. While the sutures, with completely leptophyll denticulation, of the related groups of *Proarcestes*, *Pararcestes* and *Arcestes* show a euryphyll general course of outline, one could speak, according to the outline of the sutures, almost of a stenophyll course.

Stenarcestes occurs simultaneously with *Arcestes* in the Julian deposits of Europe for the first time and belongs with *Arcestes* to the most characteristic types of the Juvavian Stage.

I. STENARCESTES.

1. STENARCESTES, n. f. ind.

1895. *Stenarcestes*, n. f. ind., E. v. Mojs., Ammonites triasiques de la Nouvelle Calédonie. Comptes rendus de l'Académie des Sciences de Paris, 18 Nov.

This specimen, chambered throughout, is for the greater part of it a cast but some remnants of the shell are preserved, so that it may be seen that only inner shell ridges were present which on the cast appear as furrows.

The whorls which widely embrace one another are somewhat broader than high and possess rounded sides which gradually merge into the well-inflated external part. The umbilicus is very narrow. In the circumference of the last whorl there are three furrows on the cast which in the lower part of the sides show a slight concavity directed forwards but otherwise maintain a tolerably straight radial course. The furrow on the cast on the external side only shows a very inconspicuous curvature towards the anterior.

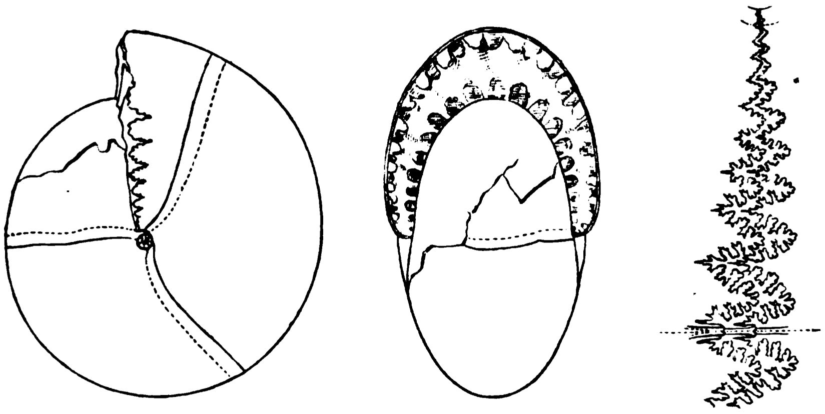
Of all European *Stenarcestes* *Stenarcestes Diogenis* (Mojs., Ceph. d. Hallst. Kalke, I Bd., Taf. LXVII, Fig. 4, Taf. LXVIII, Fig. 1, p. 145) mostly resembles the present form in outline, but no European form attains the same thickness.

As the body-chamber is unknown one must refrain from giving a special name to the form represented by this internal cast.

Sutures.—The suture-line unmistakeably shows close agreement with the type of sutures of the European *Stenarcestes*, but the features of this form would, however, offer no closer relationship to any of the named European species. There are eight auxiliary lobes present up to the umbilical suture. The deepest lobe is the external one, whose median projection shows the closest agreement with that of the European species. All the lobes terminate in one point and ascend gradually towards the umbilicus.

The saddles are very broad at the base and the septa succeeding one another interlock extensively. The leptophyll denticulation is confined to the upper halves of the saddles. The saddles terminate above, truncate with three short branches, the middle one of which appears bipartite by a short indentation. The external saddle possesses the same height as the first lateral one. From the second auxiliary saddle the leptophyll arrangement becomes completely obsolete in the broad and low auxiliary saddles.

Among the European species *Stenarcestes subumbilicatus* shows a close resemblance to the form under description. There are, however, several differences in the details of structure, as, for instance, the less depth of the external lobe, the more slender shape of the points of the saddles, the lack of the indentation in the middle branch of the points of the saddle and the finer character of the deeper lateral branches.



Stenarcestes, n. f. ind. Original in Jardin des Plantes in Paris. Reduced to 2/3 ; sutures natural size.

Dimensions.—

Diameter	73 mm.
Height of the last whorl	40 „
Thickness „ „ „	42 „
Width of the umbilicus	3 „

Locality and Geological Position.—In the dark limestone of New Caledonia (Muséum d'Histoire Naturelle du Jardin des Plantes in Paris). Number of specimens examined, 1.

II. ARCESTES, s. str., Group of ARCESTES INTUSLABIATI.

1. Arcestes Leonardi, E. v. Mojs., Pl. XX, Figs. 5—8.

On the casts of the inner chambered whorls the breadth of the whorls surpasses the height only slightly. The well-rounded external part merges in the similarly rounded sides. The umbilicus is narrow. In the circumference of one whorl there are three labiæ which arise through the direct imbrication of the old peristome over the shell as the latter increases in growth and expands anteriorly. On the inner side stronger thickenings (varices) correspond to the labia, by which the furrows on the cast appear deeper than those upon the shell. From the umbilicus the labiæ forming a cavite opening anteriorly in the lower part of the sides run to the anteriorly convex curvature, which is formed on the outer margin, after which they take their course in a straight line over the external part.

At the end of the penultimate whorl the characteristic bend of the whorl (Fig. 6), with which the change in the character of the whorl is introduced, occurs. Posteriorly to this bend is situated the last labium the external side of which coincides with the last septum, whilst the sutures on the sides of the last septum are situated anteriorly to this labium. The latter does not therefore coincide with the course of the sutures.

The last whorl of adult individuals (Fig. 5) shows a distinct increase in the height of the whorl, which is connected with a flattening of the sides as well as with the narrowing and levelling of the umbilicus.

The margin of the aperture bending inwards rests close upon the sides of the preceding whorl; the line of junction is nearly a straight one. The lumen of the peristome forms a right angle with bluntly rounded angles. On the external part the turned-in apertural margin forms a slight sinus, concave towards the anterior, so that a slight curvature convex forwards is formed by the blunt angles. The total length of the body-chamber comprises, besides the last whorl, about ¼ of the penultimate whorl, as can be seen by a comparison of the two Figures 5 and 6.

Arcestes Leonardi is among known species most closely related to *Arcestes biceps* from the Lacic beds of the Salzkammergut and is distinguished from it by the open umbilicus.

Epidermidae.—Transversely running wrinkle-like striæ ("Wrinkle-layer") have been observed.

Sutures.—The suture-line given in Fig. 8 is taken from an adult form and is the last before the beginning of the body-chamber. The course and other details agree well with the character of the sutures of *Arcestes* of the Group of *Intuslabiati*. There are on the whole five saddles up to the umbilical sutures.

Dimensions.—

	Adult specimens.	*Internal casts.*
Diameter	29 mm.	19 mm.
Height of the last whorl	17 „	10
Thickness „ „ „	14 „	10·5 „
Width of the umbilicus	1·4 „	2 „

There are also somewhat larger forms which nearly reach the size of *Arcestes biceps.*

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 14.

2. ARCESTES SUBBICORNIS, E. v. Mojs., Pl. XX, Fig. 10.

This form shows a great resemblance to *Arcestes bicornis*, Hau.[1], from the Tuvalian deposits of the Salzkammergut.

The shell, which belonged to a full-grown individual, shows an oviform elongated outline, a callus closing the umbilicus, and knee-angled bendings at the beginning of the body-chamber of the whorl on the preceding whorl (Fig. 10 *b*) here coinciding with the last labium, and an entire whorl later, posterior to the greatly depressed and narrowed peristome (Fig. 10 *a*).

The peristome shows two horn-like projections which laterally border the sinus whose concavity is directed forwards and which occurs on the external part. This peculiar structure of the apertural margin distinguishes the present form from *Arcestes bicornis,* reminding one at the same time of *Arcestes decipiens* (Ceph. d. Hallst. Kalke, I Bd., p. 133, Taf. LIV, Figs. 2, 3) belonging to the same stratigraphical horizon.

Sutures.—Not known.

Dimensions.—

Diameter[2]	18 mm.
Height of the last whorl	10 „
Breadth „ „ „	9 „
Width of the umbilicus	0 „

Locality and Geological Position.—Carnic Stage; in the black limestone on the left side of Tera Gadh, north of Kalapani. Number of specimens examined, 1.

3. ARCESTES, n. f. ind.

This fragment consisting of a body-chamber with the peristome belongs to a species of the group of *Intuslabiati,* which might, from the shape of the peristome, be most closely related to *Arcestes syngonus,* Mojs., from the Lacic marble of the Salzkammergut (Ceph. d. Hallst. Kalke, I. Bd., p. 123, Taf. XLVIII., Fig. 4).

The species attained a diameter of 101 mm. in the adult stage and had a callus closing the umbilicus. It was considerably narrower than *Arcestes syngonus.*

A fractured portion of the fragment under description shows on the preceding whorl a well-preserved labium with a forwardly convex sinus on the external part.

Locality and Geological Position.—Juvavian Stage; in the limestone complex

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[1] E. v. Mojsisovics, Ceph. d. Hallst. Kalke, Bd. I, p. 127, Taf. XLVII, Fig. 4—6.

[2] Measured at the peristome, and therefore somewhat shorter than the greatest diameter at the knee-angled bending, which amounts to 18·5 mm.

(No. 6) with *Pinacoceras* cf. *Imperator*, of the Bambanag Section. Number of specimens examined, 1.

III. PROARCESTES, Group of PROARCESTES BICARINATI.

Proarcestes, n. f. ind.

The chambered internal casts show, so far as the imperfect preservation and the inadequate knowledge of the somewhat richly serrated suture-line allow an opinion to be formed, some resemblance to *Proarcestes Gaytani* v. Klipst. (Cf. E. v. Mojsisovics, Ceph. d. Hallst. Kalke, I. Bd., p. 100, Taf. LVIII, Figs. 1-3). As distinguishing features it might be mentioned that the sides do not possess the flattening characteristic of *Proarcestes Gaytani*, but appear flatly rounded. The larger casts show no traces of shell furrows or inner shell ridges (varices), whilst smaller casts exhibit two or three weak labiæ in the circumference of the whorl.

Sutures.—So far as a comparison of the suture-line is possible it seems to possess a rather close agreement with *Proarcestes Gaytani*.

Dimensions.—

Diameter	84 mm.
Height of the last whorl	44 „
Thickness „ „ „	53 „
Width of the umbilicus	6 „

Locality and Geological Position.—Carnic Stage; in the Daonella beds of Lauka (pyritised and calcified) and Bambanag (calcified). Number of specimens examined, 4.

b. LOBITIDÆ.

1. Lobites, E. v. Mojs.

Cf. Cephalopoden der mediterranen Triasprovinz, p. 176—Cephalopoden der Hallstätter Kalke, Bd. I, p. 155.

Lobites Oldhamianus (Stoliczka).

1865. *Clydonites Oldhamianus*, Stoliczka, Mem. Geol. Surv. of India, Vol. V, Part I, p. 50, Pl. IV, Fig. 4.

1895. *Lobites Oldhamianus*, Diener, Palæontologia Indica, Ser. XV, Vol. II, Trias, Part II, p. 82, Pl. XXVII, Fig. 4.

It has already been mentioned in the introduction that this species could scarcely belong to the Anisic Stage, but belongs most probably to a horizon of the upper trias. For this reason it is spoken of here and attention is directed to the illustrations and descriptions cited above. It might well have been supposed that *Lobites Oldhamianus* was taken from a horizon of the Tyrolese Series and even from a

Carnic horizon, as up to the present time the Noric Stage has not been recognized in the Himálaya.

b. JOANNITIDÆ.

1. JOANNITES, E. v. Mojs.

1. JOANNITES, cf. CYMBIFORMIS (Wulfen), Pl. XX, Figs. 3, 4.

Joannites cymbiformis (Wulfen), E. v. Mojs., Cephalopoden der Hallstätter Kalke, Bd. I, p. 85, Taf. LXI, Figs. 1—5; Taf. LXII, Fig. 1, Taf. LXIII, Fig. 1; Taf. LV.

These specimens agree very closely with *Joannites cymbiformis*, as is to be seen from the figures of the small specimen of a cast and the suture-line. The presence of three furrows on the cast in the circumference of one whorl distinguishes *Joannites cymbiformis* from the closely related species *Joannites Joannis Austriæ*, which constantly in casts of the most variable dimensions only possesses two varices in the circumference of a whorl.

The few Indian specimens, however, which are before me, only show varices on a whorl up to 35 mm. in height, while species exceeding these dimensions did not show any varices at all. Whether in this the Indian species indicate characteristic features or merely individual differences cannot yet be decided on account of the small number of specimens suitable for examination. A further slight distinction from the typical examples of *Joannites cymbiformis* is shown in the slight curvature of the varices on the sides, but there also occur in Europe specimens which answer in this respect to the Indian casts. A close agreement with the European specimens is also shown by the Indian shells with reference to the dimensions attained. The largest individual present, which is chambered throughout, possesses a diameter of 142 mm.

Sutures.—The suture-line given in Fig. 4 agrees likewise in a remarkable manner with the sutures of *Joannites Joannis Austriæ* and *Joannites cymbiformis.* I am inclined to put to the account of individual variation the slight differences in the small details which may be observed on comparison with my illustrations of European forms. This variation is often seen in such complicated sutures and especially in the European specimens of *Joannites cymbiformis.*

The number of saddles outside the umbilical margin amounts to eight. The ninth saddle is on the umbilical margin.

Locality and Geological Position.—Carnic Stage; in grey limestone with *Traumatocrinus* and *Trachyceras tibeticum*, from Rimkin Paiar, 3 specimens; in the blackish-grey limestone with *Trachyceras* from the "cliff" opposite Ralphu glacier, left side of Lissar River, 1 specimen.

d. CLADISCITIDÆ.

1. Cladiscites, E. v. Mojs., Cf. v. Mojsisovics, Cephalopoden der mediterranen Triasprovinz, p. 173.

The genus *Cladiscites* is, according to our present knowledge, only represented in the Indian Trias Province by the group of *Subtornati*, which is distinguished from the group of *Tornati* by the peculiar formation of the first two lateral lobes. These two lobes, that is to say, reach in the *Subtornati* deep below the level of the group of lobes which gradually and evenly slope in an oblique line and are formed by the third lateral lobe and the auxiliary ones. In the group of the *Tornati*, on the other hand, such a difference in the development of the lobes does not take place and the first two lateral lobes and the external one are also arranged in the same manner as the group of lobes of the *Subtornati* formed by the auxiliary lobes and the third lateral one.

The group, therefore, of the *Subtornati*, to which, besides *Cl. subtornatus*, belong also *Cl. striatulus* and *Cl. subaratus* presently to be described, might be considered as a subgenus of *Cladiscites*, in which case the designation *Hypocladiscites* might be applied to it.

GROUP OF CLADISCITES SUBTORNATI (Hypocladiscites).

CLADISCITES SUBARATUS, E. v. Mojs., Pl. XX, Fig. 2.

This species shows in the outward shape, as also in the sutures, a great resemblance to *Cladiscites subtornatus* and was therefore recorded as *Cladiscites* cf. *subtornatus* in the geological report upon the Himálaya journey of Dr. C. Diener.

Distinctions as regards the outward shape are confined to the stronger inflation of the sides and the external part. Such a strong inflation shows itself in *Cladiscites subtornatus* only in the smaller shells representing a younger stage of growth. Specimens of *Cladiscites subtornatus* of the size of the present one of *Cladiscites subaratus*, which is chambered throughout, are more or less flattened on the external side as well as on the sides. The spiral ridges, moreover in *Cladiscites subaratus*, in specimens similar in size, are somewhat finer and more numerous than in *Cladiscites subtornatus*. Agreeing with this species the shell, sloping to the umbilicus and closed by a callus, is free from spiral ridges and perfectly smooth.

Sutures.—The most important distinctive feature, in contrast with *Cladiscites subtornatus*, is however offered by the sutures which, agreeing in general arrangement, show a considerably higher degree of denticulation. A richer development is in a striking manner especially shown in the first two large saddles. The large first lateral saddle whose inner upper chief branch rises unusually high also shows modifications in the number and arrangement of the lateral branches which can be better recognized by comparing the illustrations than by reading a description.

The number of the saddles up to the umbilical opening of the cast amounts to nine, the last seven of which in a regularly descending row succeed the large second lateral lobe which ends in a point. Remarkable also is the condition of the two lateral saddles which in contrast to the rest of the saddles and to the similar saddle of *Cladiscites subtornatus* appears not to be dimeroid in form, a circumstance which is to be considered as the result of the independent and extremely strong development of the outer upper branch of the saddle.

Dimensions.—

Diameter	119 mm.
Height of the last whorl	74 „
Thickness „ „ „	41 „
Width of the umbilicus	0 „

Locality and Geological Position.—Carnic Stage; in dark limestone of the Daonella beds of Lauka. Number of specimens examined, 1.

2. PARACLADISCITES, E. v. Mojs.

It has already been pointed out on a previous occasion (Cephalopoden der mediterranen Triasprovinz, p. 173) that the group of *Multilobati* is distinguished from the groups of *Tornati* and *Subtornati*, [as well as from *Procladiscites*, which all possess three lateral lobes, by the restriction of the lateral lobes to the number of two. The position of the lobes is therefore the normal one. The shell is smooth. Longitudinal ribs are absolutely wanting. Transversely running striæ of growth are, on the other hand, often noticeable. It seems to me advisable to express these variations in the sculpture and number of the lateral lobes by a special generic name. I therefore propose the generic designation *Paracladiscites* for the group of *Multilobati*. According to the present state of knowledge *Paracladiscites* appears in Europe for the first time in the Julian beds with *Lobites ellipticus*. The Indian specimens may in all probability be assigned also to the lower stage of the Julian beds.

The genus *Psilocladiscites* occurring in the lower stage of the Bosnian beds is to be regarded as the precursor of *Paracladiscites*; the former standing on account of the monophyll structure of the saddle in the same relation to *Paracladiscites* as *Procladiscites* does to *Cladiscites*.

1. PARACLADISCITES INDICUS, E. v. Mojs., Pl. XX, Fig. 1.

Ammonites Gaytani, MS. name.[1]

1892. *Cladiscites indicus*, E. v. Mojs., Vorläufige Bemerkungen über die Cephalopodenfaunen der Himalaya-Trias. Sitzungsberichte der kais. Akad. der Wiss., mathem.-naturw. Cl., Bd. Cl., Abath. I., p. 376.

The absence of a flattening on the sides and on the external part makes the present form appear at first sight to be an internal cast of an Arcestid, while the dimeroid structure of the sutures leaves no doubt that one has to deal here with a form from the series of the *Cladiscitidæ*.

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[1] Under this designation there are, from the collection of the Geological Survey, two fragments named by Stoliczka, one of which belongs to *Paracladiscites indicus*, but the other, undeterminable, to the species next to be discussed.

The non-umbilicated whorls, completely embracing one another, are considerably wider than high. No sharp separation takes place between the external part and the sides but the inflation of the external part gradually merges in the swelling of the sides. Also towards the callus closing the umbilicus the sides are rounded down to the steeply descending umbilical wall. The shell of which there are remnants on the sides and external part is completely smooth.

To all appearance the same, or at least a very closely related species occurs in the Julian beds with *Lobites ellipticus* of the Feuerkogel, on the Röthelstein, near Aussee. This species is represented by two specimens which will be figured in the supplement to the first volume of my "Cephalopoden der Hallstätter Kalke." The larger specimen possesses at a diameter of 75 mm. half a volution of the body-chamber, while the smaller specimen, chambered throughout, shows coarse transversely running "wrinkle" striæ upon the smooth shell.

Sutures.—The total number of the lobes cannot be exactly ascertained for the reason that the umbilical part could not be completely exposed. There are five dimeroid-shaped saddles, slightly indented, up to the steep descent of the umbilical wall, as is shown in our illustration taken from the posterior part of the last whorl.

In the specimens mentioned from the Feuerkogel there are about six saddles visible, somewhat more slender, which however may be the result of their more considerable dimensions.

Dimensions.—

Diameter	36 mm.
Height of the last whorl	21 „
Thickness „ „ „	26 „
Width of the umbilicus	0 „

Locality and Geological Position.—From the black clayey limestone of Kuling in Spiti probably belonging to the Daonella beds. Number of specimens examined, 1.

2. Paracladiscites, n. f. ind.

Ammonites Gaytani, Stoliczka, MS. name.

This is a fragment, not sufficient for description and illustration, of another species which by the flattening of the sides seems to be allied to the still undescribed *Paracladiscites timidus* from the Feuerkogel, near Aussee.[1]

The diameter of the fragment, which has a perfectly smooth shell and is chambered throughout, amounts to 40 mm.

Sutures.—Not known in detail.

Locality and Geological Position.—From the black limestone of Kuling in

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[1] The quotation of *Ammonites Gaytani* (Mem. Geol. Sur. of India, Vol. V, p. 53) by Stoliczka may well have been based upon this fragment.

Spiti belonging probably to the complex of the Daonella beds. Number of specimens examined, 1.

B. PINACOCERATOIDEA.

a. PINACOCERATIDÆ.

Pinacoceras, E. v. Mojs., cf. Cephalopoden der mediterranen Triasprovinz, p. 195.—Cephalopoden der Hallstätter Kalke, I. Band, p. 41.

1. Pinacoceras parma, E. v. Mojs., Pl. XVIII, Figs. 7, 8.

1873. Pinacoceras parma, E. v. Mojs., Das Gebirge um Hallstatt, I, Bd., p. 60, Taf. XXVI, Fig. 2.
1873. Pinacoceras sub-parma, E. v. Mojs., l. c., p. 61, Taf. XXVI, Fig. 3.

The differences between *Pinacoceras parma* and *Pinacoceras subparma* are so slight that it seems to me to be more advisable for the present to regard *Pinacoceras subparma* as only a variety of *Pinacoceras parma*. *Pinacoceras subparma*, that is to say, is only distinguished by the small accessory saddle occurring in the first (external) auxiliary lobe. This saddle, as a comparison with *Pinacoceras parma* shows, can only be regarded as the freed large outer accessory branch of the first auxiliary saddle. A further difference between the two forms mentioned consists in the more slender form of the principal saddles in *Pinacoceras subparma*.

The present Indian specimens are individuals of moderate dimensions and chambered throughout. The shape agrees with that of the shell in the European specimens of the *Metternichi* group. The extraordinarily narrow shell, with contracted umbilicus and therefore closely embracing whorls, forms a narrow knife-like edge on the external part which on its inner side on the chambered part of the shell forms a tube which is bounded by the chambered lumen.

The shell is either quite smooth or shows only slight indications of falciform folds when viewed with the light falling obliquely upon it.

Sutures.—The sutures are, as our illustration indicates, in the closest agreement with those of the European specimens. There are five adventitious, three principal and eight auxiliary lobes. The first adventitious saddle shows the large outer accessory branch, as in the typical specimens of *Pinacoceras parma*. The principal saddles possess the more slender, pyramidal form, as in the figured variety of *Pinacoceras subparma*. The greater height of the principal saddles may in both cases be connected with the more youthful stage of growth from which the drawings of the sutures were taken. In the more advanced stage, as has often been stated, the saddles may have been more widened and therefore have lost in height.

The number of the auxiliary saddles outside the umbilical margin amounts to eight, being thus somewhat fewer than in the rest of the larger European specimens. This distinction may also be attributed only to the more youthful stage of growth of the Indian specimens.

Dimensions.—

Diameter	84 mm.
Height of the last whorl	45 „
Thickness „ „	10 „
Width of the umbilicus	8 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

2. PINACOCERAS, indet., Pl. XIX, Fig. 1.

The figured fragment which has suffered on both sides from weathering is unfortunately only sufficient to establish its ascription to the series of forms of *Pinacoceras imperator*, which begins in the lower stage of the Bosnian beds with *Pinacoceras Damesi* and dies out with *Pinacoceras imperator* in the Sevatic deposits.

As the front view, Fig. 1 b., shows, the septal unfolding is very slight though the number of auxiliary lobes is very considerable. In consequence of this a very deep sinking back of the auxiliary lobes takes place in the manner of an umbilical lobe extending far back. According to this view the character of the external part of the preceding whorl can also be assumed. The blunt edge of the shell rising like a hollow keel over the external flattened chambered cast is distinctly to be seen.

It does not seem as if the present fragment could be referred to a known species. Neither can it be decided with certainty whether it is nearer to the Carnic *Pinacoceras Rex*, or the Juvavian *Pinacoceras imperator*.

The large dimensions and the slight curvature of the suture-line might, it is true, indicate that we have to deal here with a species closely related to *Pinacoceras imperator*.

The number of the adventitious lobes cannot be given. The number of the auxiliary lobes distinguished by their small size amounts to twelve for the portion lying outside the rectangular umbilical edge.

Locality and Geological Position.—Juvavian Stage; in the Limestone complex No. 6 (Hauerites beds) of the Bambanag Section. Number of specimens examined, 1.

2. BAMBANAGITES, E. v. Mojs.

The high-mouthed disc-shaped shells are provided with falciform folds, which are close together on the external part, and this is blade-like in the young, being sometimes ornamented with external tubercles and flattened on the body-chamber in the adult.

The suture-line consists of three adventitious, two principal and a number of auxiliary lobes and slightly serrated saddles, rounded above in a monophyll manner. A dimeroid bifurcation is here and there indicated in the auxiliary saddles, in which case the saddles attain double the width of the otherwise very narrow saddles. The adventitious lobes show a slight ascent. The first principal lobe reaches the greatest depth and width. On the side walls of the adventitious and chief saddles there are a few lateral branches which show an inclination towards a phylloid rounding.

Bambanagites, it is true, reminds us of *Pinacoceras Layeri* by its sculpture, but it cannot however be considered a descendant of Pinacoceras on account of the simple and primitive structure of its sutures. On the other hand it is very probable that both genera—*Bambanagites* and *Pinacoceras*—originate from a common root, and according to our knowledge of the development of the phylloid type of sutures the immediate ancestors of *Pinacoceras* might have possessed sutures similar to those of *Bambanagites*.

The length of the body-chamber amounts to somewhat more than half of the last whorl.

Bambanagites is so far only known from the Halorites Limestone of the Himálaya.

1. Bambanagites Schlagintweiti, E. v. Mojs., Pl. XVIII, Figs. 1, 2.

The chambered parts of the shell show closely embracing, very narrowly umbilicated and high-mouthed whorls, whose slightly inflated sides merge into a truncated, blade-like external part having an uninterrupted margin. The shell is almost completely smooth on the inner whorls. In the specimen represented in Fig. 2 some faint traces of falciform folds occur only at the end of the last whorl. Also the large form, Fig. 1, with the body-chamber preserved, shows at the beginning of its last whorl only a faint sculpture, which attains its full strength only later on.

On the body-chamber which occupies somewhat more than half of the last whorl there occurs a change in the shape of the volution, for the external part, which still forms a blunt blade in the posterior third of the last whorl, gradually widens and becomes rounded to present itself finally, at the end of the body-chamber, as a well-characterized slightly inflated area, separated from the sides by rounded edges. Simultaneously with this characterisation of the external area there also occurs a flattening of the sides.

As at the aperture, the lower part of the sides on the left half of the shell somewhat projects, it is to be supposed that here practically the mouth-margin which agrees in its course with the direction of the sculpture is present.

The sculpture of the body-chamber whorl consists of falciform folds which are divided into two regions of varying strength by a spiral line running above the middle of the sides. Thus on the lower area, extending towards the umbilicus, the folds are extraordinarily weakly developed. Somewhat outside the anteriorly convex projection, or rather at the same place at which the spiral line runs, a strengthening of the sculpture occurs. On the anterior portion of the body-chamber provided with the flattened external part the broad flattened fold-like ribs unite together on this external area coming from both sides. Very often there are no bifurcations of the fold-like ribs in the region of the spiral line. Fusions of the fold-like ribs in the anterior part of the body-chamber may also be mentioned as occurring on the spiral line as well as outside of it.

It is necessary to direct attention to the fact that the anteriorly convex arch which distinguishes the middle of the falciform curvature of the fold-like ribs forms a lappet at the sides, reaching beyond the external part. The latter therefore shows, in comparison to this lateral lappet, a backwardly directed sinus.

Sutures.—Besides the three adventitious lobes there are to be counted two lateral and from eight to nine auxiliary ones situated outside the umbilical margin. The external adventitious lobe which takes the place of the external lobe is divided by a wide median projection into two halves, which are divided again by a small denticle into two points. The two following adventitious lobes are one-pointed.

The first lateral lobe is divided by two projecting denticles into three points. It is therefore rather wide and reaches the greatest depth of all the lobes, for at the side of the adventitious lobes as well as at that of the second lateral and the auxiliary ones an ascent of the lobes takes place. The second lateral lobe is two-pointed and the auxiliary lobes appear indistinctly rounded. They are mostly very narrow. Their number cannot be exactly fixed, for the reason that one remains in doubt whether some shorter indentations dividing the saddles are to be regarded as lobes or as divisions of the saddles.

The saddles increase in height up to the first lateral saddle, which reaches the greatest height, and decrease in height rapidly towards the umbilicus. They end above with a large "leaf," which only in the second and third adventitious saddles as well as in the first lateral one shows traces of slight notches. Also the little lateral branches of the larger saddles show a tendency to the phylloid structure. The auxiliary saddles have no lateral branches.

Dimensions.—

Diameter	80 mm.
Height of the last whorl	44 „
Thickness „ „	17 „
Width of the umbilicus	2 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 2.

2. Bambanagites Dieneri, E. v. Mojs., Pl. XVIII, Figs. 3—6.

The series of variations of this beautiful species shows such remarkable deviations in the character of the sculpture that one might be induced to make out several different species. Nevertheless closer investigation shows that the differences so striking in the extreme varieties are connected by gradual transitions. It is also shown that the variability is so great that each of the specimens under description shows certain peculiarities by which it is distinguished from the rest.

Bambanagites Dieneri resembles in the form of the whorls the closely related *Bambanagites Schlagintweiti*, from which, however, it is distinguished essentially by the much smaller dimensions and the beginning of the sculpturing already occurring on the chambered parts. Another feature separating the two forms, so far not connected by any transitional form, is afforded by the characteristic external tubercles which distinguish *Bambanagites Dieneri* but are likewise only present in a small degree in individuals with faintly developed sculpture. These external tubercles are caused by the union of the fold-like ribs on the blade-like edge of the external side coming from both sides of the shell. On the body-chambers of adult specimens these external tubercles are obliterated simultaneously with the gradual beginning of the rounding and flattening of the external part.

The variability in the strength of the sculpture can be seen in our illustrations. In one of the most extreme individuals, Fig. 3, actual pits are visible on the posterior side of the folds on the anteriorly convex sharp bending of the folds. The latter are wide and strongly developed and, bifurcating once or twice, run to the external part in an anteriorly concave arch. The shell on the lower half of the sides appears almost smooth.

The sculpture in the form represented in Fig. 4 is less strongly developed. The folds take more the character of ribs which outside the spiral, dividing the sculpture on the sides, do not as a rule bifurcate at all, or only once, but exceptionally also twice. The rarer occurrence of bifurcations is caused by the fact that the number of the folds running from the spiral division is a larger one.

The form, Fig. 5, is distinguished by the complete characterisation of the ribs which present themselves here as transverse folds. Single ribs, especially on the body-chamber, appear to be longitudinally divided in the vicinity of the outer margin.

The sculpture in the individual represented in Fig. 6 appears very much weakened.

Sutures.—The suture-line (Fig. 6^{c}) shows great general agreement with the sutures of *Bambanagites Schlagintweiti*. Remarkable however is the slight depth of the second adventitious lobe, as well as the development of the auxiliary saddles into dimeroid saddles. It seems as if by a fusion of every two neighbouring simple auxiliary saddles of the type of the auxiliary saddles of *Bambanagites Schlagintweiti* the dimeroid-shaped auxiliary saddles of *Bambanagites Dieneri* were developed. In harmony with this view may also be mentioned the small number of auxiliary saddles occurring in *Bambanagites Dieneri*, of which only four can be observed up to the edge of the umbilicus. *Bambanagites Schlagintweiti* possesses double the number of auxiliary saddles.

Dimensions.—

Diameter	54 mm.
Height of the last whorl	31 „
Thickness „ „	12 „
Width of the umbilicus	2 „

Locality and Geological Position.—Juvavian stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 7.

3. PLACITES, E. v. Mojs.

1873. Gruppe des ***Pinacoceras platyphyllum,*** E. v. Mojs., Das Gebirge um Hallstatt, I. Heft, p. 49.

1866. *Placites*, E. v. Mojs., Über den chronologischen Umfang des Dachstein kalkes. Sitzungsber. der kais. Akad., math.-naturw. Cl., Bd. CV., Abth. I., p. 18.

It seems to me advisable to separate this group, distinguished by a rounded external part and a small number of adventitious lobes, from the typical Pinacoceratidæ under a special generic name.

The high-mouthed shells are in the Carnic species narrowly umbilicated, but they are as a rule in the Juvavian forms, on the other hand, un-umbilicated (*i.e.*, closed by a callus).

In the greater number of forms there is only one (external) adventitious lobe, which is succeeded by two large principal lobes, the second of which is generally the most deeply reaching one and therefore corresponds to the first lateral lobe of the Ammonites, without adventitious lobes. Only in *Placites perauctus* there are three adventitious lobes, and this type comes nearest to the typical Pinacoceratidæ on account of the dimeroid structure of the adventitious saddles. It is very noteworthy that the adventitious lobes, which occur besides the external adventitious lobe, develop themselves from the adventitious saddle by bifurcation. The adventitious saddle may be dimeroid or one-pointed. Of the two chief saddles the first is always one-pointed, the second being in most cases also so. Only the succeeding saddles are dimeroid.

Placites shows a great outward resemblance in its shape to involute *Gymnites*, for example, to *Gymnites subclausus*, Hauer, from the Bosnian Stage.[1] The analogy is essentially strengthened by the fact that the indication of an adventitious lobe also exists in this species in consequence of the bifurcation of the external saddle.

The question as to the possible derivation of the genus *Placites* from *Gymnites*, widely umbilicated in their older representatives, but visibly more narrowly umbilicated in their younger ones, must for the present be left open.

But I should like to draw attention here to analogies which seem to bring *Placites* into relationship with certain Cladiscitidæ. Putting aside the spiral striation, *Procladiscites Brancoi*, *Hypocladiscites subaratus* and *Hypocladiscites subtornatus* not only show a certain agreement in outer form, but also in the disposition of the sutures. With reference to the latter one may for instance compare the sutures of *Placites Oldhami* (Pl. XIX, Fig. 2) with the lobes of the above-named Cladiscitidæ. The first two deep lateral lobes find their corresponding representatives in the two large principal lobes of *Placites*. I am inclined to think that a greater significance ought to be attached to the analogies with the Cladiscitidæ than to the resemblances with *Gymnites*. Nevertheless I deem it advisable to hold my opinion about it in suspense.

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[1] Denkschr. der kais. Akad. der Wissensch., math.-naturw. Cl., Bd. LIV, p. 33, Taf. VII, Fig. 5.

True *Placites* occur, according to our present knowledge, for the first time in the Julian period. The genus reaches specially rich development, however, only in the Juvavian Stage, at the end of which it also dies out.

2. PLACITES, ind. ex aff. Pl. PERAUCTI, Pl. XVIII, Fig. 9.

1873. *Pinacoceras perauctum*, E. v. Mojs., Das Gebirge um Hallstatt, I. Bd., p. 53, Taf. XXI, Figs. 7, 8.

The undeterminable chambered fragment belongs to a species related to *Placites perauctus*, as is shown by the occurrence of three adventitious lobes. This type is already found in the Mediterranean Trias Province of Europe, in the Julian deposits; but these latter occurrences (cf. loc. cit. *Pinacoceras* cf. *perauctum* p. 53) are likewise imperfectly known.

Locality and Geological Position.—Carnic Stage; in the upper Daonella Beds of the Bambanag Section. Number of specimens examined, 1.

2. PLACITES OLDHAMI, E. v. Mojs., Pl. XIX, Fig. 2.

The high-mouthed smooth shell possesses an umbilicus with a narrow opening, which is bordered by a steep umbilical wall. The sides are very flat and scarcely perceptibly inflated. The external part is rounded.

Sutures.—According to the structure of the sutures *Placites Oldhami* is to be assigned to the group of *Placites platyphyllus*. Decisive for this allocation is in the first place the adventitious saddle, with its low lateral branch attached to its outer side in an oblique position. This branch, as the Mediterranean forms of *Placites* show, is to be regarded as a rudimentary, smaller, adventitious saddle. The character also of the auxiliary saddles which do not show the deep bifurcation characteristic of the group of *Placites symmetricus* does not contradict this ascription to the group of *Placites platyphyllus*. But it is to be observed that the outer lateral branch, mentioned above, is proportionally weakly developed and does not attain the dimensions which are reached by the Mediterranean species of the same group, though belonging to a higher horizon.

The external lobe, designated here the adventitious lobe in harmony with the terminology applied to the European species, is considerably shallower than the two succeeding chief lobes, and divided into two diverging two-pointed halves by a trapeze-like median projection.

The second of the two large principal lobes which performs the function of the first lateral lobe of Ammonites with normal sutural arrangement reaches somewhat lower than the first. Both are two-pointed at their base. But smaller denticles indicate at the base of the first principal lobe a further division of the two chief points.

The first of the twelve successive lobes, descending arch-like to the umbilical suture, performs the function of the second lateral lobe (*i.e.*, the third principal lobe), though it appears outwardly already as auxiliary lobe; while the other eleven are to be regarded as true auxiliary lobes. The larger of them are divided into two points, but a division cannot be observed in the smaller ones. The saddles are rather simply constructed and the dimeroid arrangement is only shown in the auxiliary saddles. The first principal saddle reaches the greatest height.

Dimensions.—

Diameter	45 mm.
Height of the last whorl	26 „
Breadth „ „	9 „
Width of the umbilicus	2 „

Locality and Geological Position.—Carnic Stage; in the Daonella beds of Lauka. Number of specimens examined, 1.

3. PLACITES SAKUNTALA.—E. v. Mojs., Pl. XIX, Figs. 3, 5.

This species is distinguished from *Placites Oldhami* by the umbilicus closed with a callus, the stronger inflation of the sides and the differently shaped, richly denticulated sutures.

Faint falciform transverse striæ are shown (Fig. 5) on the shell, which is in good preservation. They describe a widely expanding arch, anteriorly convex, on the upper half of the side, similar to that in the genus *Bambanagites.*

Sutures.—Placites Sakuntala represents, having regard to the structure of the sutures, an independent type which cannot be included, without reservation, in any of the groups differentiated up to the present time in the Mediterranean trias. *Placites polydactylus* (Cephal. der Hallst. Kalke, I. Band, p. 52, Taf. XXI, Fig. 4) shows the greatest resemblance in the structure of the lobes, but there are also many remarkable differences between this form and the present one. Thus *Placites polydactylus* possesses the outer lateral branch on the adventitious saddle characteristic of the group of *Placites platyphylli,* whereas in *Placites Sakuntala* this branch is, as a rule, completely absent.

The three drawings given of the sutures show the mode of development in the different stages of growth. It is seen that the growth of the new sutural elements takes place from the side of the umbilicus. The increase of the denticulation and characterisation with age are also to be observed.

The small size as well as the almost symmetrical form of the adventitious saddle are very remarkable, the externally situated lobe being thereby proportionally deep. The two large principal lobes reach nearly the same depth. The first of the eight lobes, descending to the umbilicus in a series of auxiliary lobes, is, from its relations to the preceding whorl, still to be regarded as a lateral or principal lobe.

As an important distinctive point compared with *Placites polydactylus* it is to be observed that only the large first principal saddle shows the wedge form. The dimeroid shape of the saddles begins therefore already with the second principal saddle. The second principal saddle in *Placites polydactylus* has on the other hand a wedge-shaped outline quite similar to that of the first principal saddle.

One of the specimens under description which we regard as a variety of *Placites Sakuntala*, is distinguished from all the other forms by the presence of the above-mentioned outer lateral branch on the adventitious saddle. Through this circumstance we get an indication that *Placites Sakuntala* might nevertheless be in closer relationship with the group of *Placites platyphylli* than would otherwise be supposed.

Siphuncle.—Almost all the specimens under examination possess a cord running uninterruptedly and representing a well-preserved siphuncle. There was therefore most probably a horny siphonal covering present.

Dimensions.—

Diameter	40 mm.
Height of the last whorl	25 „
Thickness „ „	10 „
Width of the umbilicus	0 „

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 14.

b. MEGAPHYLLITIDÆ.

1. MEGAPHYLLITES, E. v. Mojs.

1878. Dolomitriffe von Südtirol und Venetien, p. 48.
1879. Vorläufige Uebersicht der Ammoniten-Gattungen der Trias. Verh. der k. k. Geol. R. A., p. 135.
1882. Cephalopoden der mediterranen Triasprovinz, p. 191.

Of this genus so widely distributed in the Mediterranean trias only a single fragment, rather imperfectly preserved, but undoubtedly generically connected with it, has been found in the Indian trias. In Europe *Megaphyllites* belongs to the more numerous specimens, especially in the deposits poor in clay, of the Cephalopodfacies. Whether their rarity in the Himálaya is connected with the prevalence of the Cephalopod-bearing rocks richer in clay, or whether it may be attributed to the local peculiarities of the Indian Trias Province, must for the present remain an open question.

MEGAPHYLLITES, f. ind.

Cf. *Megaphyllites Jarbas*, Münster E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, Bd. I, p. 47, Taf. XIX, Figs. 9, 10, 16. Cephalopoden der mediterranen Triasprovinz, p. 193, Taf. LIII, Figs. 7, 8.

This chambered cast converted into brown ironstone only possesses a diameter of 11·5 mm. and has suffered by weathering. A specific determination is therefore not attainable. The shape of the shell reminds us most strongly of

Megaphyllites Jarbas, and the sutures also, though damaged by weathering, well admit of comparison with that species. The only specimen present comes from the slates of the Daonella beds to the south of the Uttadurrha Pass.

c. LYTOCERATIDÆ.

1. MOJSVARITES, Pompecky.

1882. *Monophyllites*, E. v. Mojs., *pro parte*, Cephalopoden der mediterranen Triasprovinz, p. 204.
1895. *Mojsvarites*, Pompecky, Ammoniten des Rhät. Neues Jahrb. fur Min., Geol. u. Paläont. II. Bd., p. 19.

MOJSVARITES EUGYRUS, E. v. Mojs., Pl. XIX, Fig. 7.

1873. *Lytoceras eugyrum*, E. v. Mojs, Das Gebirge um Hallstatt, I. Bd., p. 34, Taf. XIX. Figs. 12, 13.

This form with its numerous slowly increasing whorls agrees perfectly with the specimens from the Julian Hallstatt Limestone of the Feuerkogel near Aussee, but the thickness of the whorls appears too great and consequently also the inflation of the sides much too conspicuous in the illustration here given (Fig. 7b), which represents the anterior somewhat crushed portion of the last whorl restored.

Sutures.—In spite of the smaller size the finer details at the base of the first lateral lobe and the lateral branches of the first lateral saddles are distinctly perceptible when compared with *Mojsvarites Agenor* (Cf. *Monophyllites Agenor*, E. v. Mojsisovics, Ceph. d. mediterranen Triasprovinz, p. 205, Taf. LXXVIII, Figs. 6—9).

Dimensions.—

Diameter	13	mm.
Height of the last whorl	4·4	„
Breadth „ „ „	3·5	„
Width of the umbilicus	5·8	„

Locality and Geological Position.—Carnic Stage; in the Daonella beds (No. 5) of the Bambanag Section, 1 specimen; in the same beds near Kiangur, 1 specimen.

2. PHYLLOCERAS, Ed. Suess.

1865. *Phylloceras*, Ed. Suess, Ueber Ammoniten. Sitzungsber. der kais. Akad., math.-naturw. Cl., Bd. LII, Abth. I, p. 66.
1873. *Phylloceras*, E. v. Mojs., Das Gebirge um Hallstatt. I. Bd. I. Heft, p. 36.
1885. *Racophyllites*, K. A. v. Zittel, ex parte, Handbuch der Paläontologie, Bd. II., p. 439.
1889. *Racophyllites*, Steinmann, ex parte, Paläontologie, p. 420.

I consider the triassic forms which are grouped round *Phylloceras neojurense* as the direct ancestors of the jurassic Phylloceratidæ, whilst v. Zittel and Steinmann assign these triassic forms to the genus *Racophyllites* and regard the genus *Megaphyllites* as the primitive form of the genus *Phylloceras*.

With reference to the genus *Megaphyllites* emphasis must be laid upon the circumstance that all the Carnic and Juvavian species are un-umbilicated (closed with a callus) and always provided with exclusively one-leafed terminations of the saddles. The genus *Phylloceras* possesses an open umbilicus, and it is most improportion of the saddles from the lobes of *Phylloceras patens*, as may be seen from a comparison of the figures.

Dimensions.—

Diameter	74 mm.
Height of the last whorl	29 „
Thickness „ „ „	22 „
Width of the umbilicus	27 „

Locality and Geological Position.—Carnic Stage; in the Daonella beds of Lauka, Number of specimens examined, 1.

d. PTYCHITIDÆ.

1. PTYCHITES, E. v. Mojs. Cf. Cephalopoden der mediterranen Triasprovinz, p. 244.

PTYCHITES POSTHUMUS, E. v. Mojs., Pl. XIX., Figs. 8, 9.

Whilst the suture-line is of such a character as to admit of no doubt that we are dealing in the present form with a *Ptychites*, the last whorl (Fig. 9) consisting of the body-chamber for the greater part shows some divergence on account of which we cannot determine whether we have to deal with originally organic or late mechanical deformations.

After the bending of the last whorl, which reminds us of the bendings of the whorl at the beginning of the body-chamber in *Arcestes*, a deviation from the spiral takes place with a turn to the left.[1] A depression of the whorl occurs simultaneously. The margin of the mouth is, it is true, not preserved, but the specimen of the body-chamber (Fig. 9) is to be regarded as nearly complete, as it almost occupies the whole of the last whorl. The cast of the inner chambers (Fig. 8) completely recalls the Rugifer type. The spherical shell possesses a narrow umbilicus, bordered by a sharp edge and shows faint traces of transverse folds.

Sutures.—The external lobe is proportionally deep, reaching nearly to the depth of the first lateral lobe. It separates itself, it is true, by this feature from the character of this lobe in the geologically older typical Rugifers. But the narrow fine external saddle, appearing somewhat too wide in our illustration, thoroughly recalls the Rugifer type, though it must be admitted that the present small species shows a tendency to a more distinct characterisation of the external lobe and saddle. The two lateral saddles and the two following auxiliary saddles are bifurcated in the middle into two parts. The external saddle terminates above in two lappets, and the first lateral saddle in three.

Dimensions.—In consequence of the imperfect preservation preventing a reconstruction the usual measurements are not possible in the body-chamber specimen. We must therefore be content to mention that the diameter at the place of the knee-shaped bend amounts to 21 mm.; and that more anteriorly, after the beginning of the depression in the region of the mouth, it is only 20 mm.

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[1] *N.B.*—The drawing which is done without the help of a mirror is reversed.

Internal casts give the following measurements :—

Diameter	14·5 mm.
Height of the last whorl	7·5 „
Thickness „ „ „	10·5 „
Width of the umbilicus	1·5 „

Locality and Geological Position.—Carnic Stage; in black limestone facing the Ralphu Glacier, on the left bank of the Lissar River. Number of specimens examined, 4.

Hungarites, E. v. Mojs. Cf. Cephalopoden der mediterranen Triasprovinz, p. 221.

Hungarites nitiensis, E. v. Mojs.

1865. *Ammonites floridus* (Wulfen) juv., Salter, Palæontology of Niti, p. 61, Pl. 8, Fig. 1 (not Figs. 2 and 3, not Pl. 6, Fig. 1).

Through the kindness of Dr. Henry Woodward I have before me the plaster casts of the two original larger specimens figured by Salter and preserved in the British Museum in London. By a happy chance I found among the specimens collected by Dr. Diener in the Carnic Crinoid Limestone of Rimkin Paiar a small cast, which belongs to the same species as Salter's, showing the sutures, figured here of the natural size.

The slender narrowly umbilicated shell consists of high-mouthed very widely embracing whorls, with slightly inflated sides and a truncated narrow external part, which has a central keel, flat at first, then accompanied by deeply-sunk keel-furrows. The latter are bordered on the outer edge by sharp rims which viewed from the external side produce the effect of marginal keels.

The lateral sculpture consists of very faint folds which appear very fine and weak in the small specimen from Rimkin Paiar, but in Salter's specimens they are larger and more distinctly developed. They are slightly curved sigmoidally and produce knotty swellings on the outer margin which form true marginal spines in the larger of Salter's forms.

It must be recognized that the habit of the present shell reminds us above all of the young form of *Carnites floridus* (Cf. Cephal. der medit. Triasprovinz, Taf. L and LI) among all known triassic Ammonites. Whether, however, we have here a type standing in closer relation with *Carnites* (which according to the ontogenetic bable that its ancestors were un-umbilicated. Forms which would make a transition from the one-leafed saddles of the genus *Megaphyllites* to the saddles of the genus *Phylloceras* terminating in two or three leaves are moreover entirely wanting. Its concentrated proportions of growth connected with its small size, a circumstance that is according to my experience to be observed only in dying-out stocks (compare the genera *Parapopanoceras*,[1] *Nannites*, *Lobites*, *Tropiceltites*, *Styrites* and *Celtites*) is another remarkable peculiarity of *Megaphyllites*. I consider *Megaphyllites* as a genus becoming extinct without descendants at the uppermost trias boundary.[2]

Phylloceras neojurense and its contemporaries from the same group are distinguished from the typical representatives of the genus *Phylloceras*, as for instance from *Phylloceras heterophyllum*, only by the wider umbilicus and the smaller number of the auxiliary lobes connected with the lesser degree of involution. The genetic development of involute forms out of evolute ones is among the Nautiloids and Ammonoids however such a generally recognised phenomenon that to enlarge upon it would be rather superfluous. But attention may here be drawn to the studies of M. Neumayr[3] on the ontogenetic development of different jurassic species of *Phylloceras*. The sutures of *Phylloceras neojurense* are the typical *Phylloceras* sutures, and it need only be pointed out that only the three chief saddles on each half of the shell show the diphyll or triphyll termination of the saddles, while the succeeding ones are always monophyll. This feature is evidenty connected with the slight degree of involution of the shell.

Out of the evolute species of *Phylloceras* are developed on the one hand the strongly involute typical species of *Phylloceras* of the Jura, and on the other hand the sub-genus *Rhacophyllites*, Zittel, which is distinguished by inclined auxiliary lobes and a variable body-chamber and is confined to the lias.

Phylloceras descends, as I already mentioned in the year 1873,[4] from the triassic ancestors of the genus *Lytoceras*, which I have later distinguished as *Monophyllites*.

Of the two stocks which I have designated as *Monophyllites*, the series of forms of *Monophyllites sphaerophyllus* or *Monophyllites* s.s. may be regarded as precursors of the genus *Lytoceras*, and the group of *M. Agenor*, distinguished by Pompecky under the generic name *Mojsvárites*, as the source of the genus *Phylloceras*.

Transitional forms between *Mojsvárites* and *Phylloceras*—forms that may be attributed to one or the other of these genera at discretion—are *Phylloceras patens* from the Lacic Hallstatt Limestone and the Indian *Phylloceras Ebneri*, which will be described below.

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[1] I agree with Haug's proposal to separate from the permian Popanoceratids the Popanoceratids described by me from the Arctic trias, under the generic designation *Parapopanoceras* forms which are already completely in the Ammonitic stage of development.

On the other hand it is incomprehensible to me that Haug should place the two genera so closely allied and in direct descent in two different sub-orders, and that thus *Popanoceras* should be put in the sub-order *Triaenidia* and *Parapopanoceras* in the sub-order *Prionidia*.

[2] Pompecky, Ammoniten des Rhät. Neues Jahrb.—für Mineral, etc., 1895, Bd. II., p. 23.

Jahrb. Geol. R. A., 1871, p. 305.

[4] Gebirge um Hallst. Bd., I. Heft, p. 36.

The genus *Phylloceras* occurs, according to the range here adopted, for the first time in the Julian beds.

PHYLLOCERAS (MOJSVARITES) EBNERI, E. v. Mojs., Pl. XIX., Fig. 6.

This species is, like *Phylloceras* (*Mojsvarites*) *patens*, a transitional form from *Mojsvarites to Phylloceras* and depends upon an arbitrary decision as to whether it is to be referred to the one or to the other genus. The slowly increasing whorls only embracing one another on the external part are higher than wide and possess a smooth shell. The external part is narrowly inflated and gradually passes into the gently-rounded sides. The umbilical margin is rounded, its wall overhanging. The umbilicus is, in consequence of the slight involution, widely opened.

Phylloceras Ebneri is distinguished outwardly only very slightly from the closely related *Phylloceras patens* occurring in the Lacic division of the Juvavian Hallstatt Limestone (*Lytoceras patens*, E. v. Mojsisovics, Ceph. d. Hallstätter Kalke, I. Bd., p. 34, Taf. XVI., Fig. 13, Taf. XIX., Fig. 17) by the somewhat different transverse section of the whorls caused by their lesser height.

Sutures.—The ill state of preservation which makes the present fragment very fragile unfortunately prevents the complete exposure of the external saddle. It seems, however, that this was similarly shaped to that of *Phylloceras patens* and that thus it was monophyll, provided with a large terminal leaf, rounded above, the convexity of which was directed towards the first lateral lobe, but the concavity towards the external lobe. A second deeper-lying leaf, which, however, did not reach the height of the large terminal leaf, seems to have been turned towards the external lobe. The beginning of the diphyll development is therefore indicated also on the external saddle, in spite of the monophyll plan here unmistakable. The character and the depth of the external lobe could not unfortunately be observed.

The two lateral saddles are distinctly diphyll. But the somewhat stronger development of the outer terminal leaf, which is especially observable in the second lateral saddle, recalls its monophyll origin.

The lobe situated on the umbilical margin is to be regarded as the third lateral lobe, according to its position in relation to the projection of the preceding whorl. The first lateral lobe which reaches the greatest depth is arranged in three larger points divided by denticles with entire margins; the middle and deepest of these points is subdivided again by smaller denticles and points. The outer point also shows a secondary serration at its base. The second lateral lobe is provided with two larger points, which are again divided. The character of the third lateral lobe is not distinctly observable.

The suture-line as described differs in the details of the lobes and the lower development of *Carnites floridus* would not be impossible) cannot be determined with the insufficient material at command.

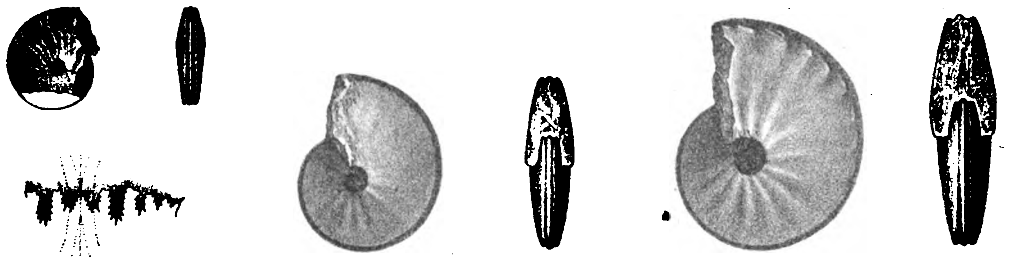

Fig. 1. Fig. 2. Fig. 3.

Hungarites nitiensis.

Fig. 1. Chambered casts of the natural size, from the Crinoidal limestone with *Trachyceras tibeticum* from Rimkin Paiar. Sutures enlarged.

Figs. 2, 3. After drawings taken from plaster casts of Salter's original specimens from Niti Pass. Natural size.

But in any case it must be pointed out that the character of the external part as well as the development of the sutures in *Hungarites nitiensis* are distinguished from the geologically older representatives of the genus known up to the present time. The possibility must, however, be kept in view that the necessity for the erection of a new genus may arise when sufficient material has been obtained.

Sutures.—The suture-line is, in contrast to the older *Hungarites*, no more in the ceratitic stage of development, but is decidedly brachyphyll, a circumstance that deserves the more attention as even the small specimen from Rimkin Paiar which forms the subject of our illustration and description has already very highly developed sutures. Another peculiarity is the slight depth of the external lobe, which is the more striking, as the first lateral lobe is distinguished by very considerable depth. The arrangement of the sutures is normal. There are only two lateral lobes, which even in this young cast are followed by two auxiliary lobes down to the umbilical margin. Salter's drawing of the sutures which is reproduced from the larger specimen, illustrated in Fig. 2, shows four auxiliary lobes. This specimen has, it must be remarked, suffered through weathering, and the difference in Salter's drawing of the first lateral lobe, which appears to be not deep enough, is probably to be traced to this circumstance. The external lobe which reaches over the outer margins to the sides is divided into two one-pointed diverging branches by a median projection. The latter is broad rising in a blunt pyramid, provided with two lateral branches. The larger of these lateral branches coincides with the outer margins and reminds us of a similarly situated branch in *Hungarites Pradoi* (Ceph. d. med. Triasprovinz, Taf. XXXII., Fig. 7). The two lateral lobes, the second of which reaches to about the depth of the external lobe while the first is, as already mentioned, distinguished by great depth, are divided into three points by two branches rising from their base, the auxiliary lobes showing only a two-pointed division.

The saddles are very slender and provided with notches which cut very deeply into their walls. The summits of the saddles appear, it is true, with an unbroken margin, not with a sharply rounded but a somewhat irregular outline, which may be regarded as a stage preceding the notching. The external saddle and the first lateral one may have about the same height.

Dimensions.—

Diameter	30 mm.
Height of the last whorl	14·5 „
Thickness „ „	9 „
Width of the umbilicus	8 „

Locality and Geological Position.—Carnic Stage; in the Crinoidal limestone of Rimkin Paiar and in the Niti Pass. Number of specimens examined in the former locality, 1; in the latter, 2.

NAUTILEA.

A. GYROCERATIDÆ.

1. PLEURONAUTILUS, E. v. Mojs., Cf. Cephalopoden der mediterranen Triasprovinz, p. 273.

1. PLEURONAUTILUS TIBETICUS, E. v. Mojs., Pl. XXI., Fig. 3.

This shell, chambered throughout, is closely related in the form of the whorls as well as in the sculpture of the shell to *Pleuronautilus Wulfeni* (E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, I. Bd., p. 10, Taf. VII, Fig. 3) from the Julian beds of the Alps.

The shell, moderately increasing, consists of somewhat more than one and a half whorls. The umbilicus is perforated in the innermost whorl. The innermost whorl begins very bluntly, increases very quickly to a considerable thickness and height and then continues growing in both directions in a very moderate degree. This blunt embryonal part has very distinctly marked transverse striæ on the shell; these are crossed by fainter longitudinal striæ. At the beginning of the second fourth of the inner whorl, simultaneously with the development of an umbilical margin and the flattening of the sides, there occur transverse ribs, faint and following one another at rather wide intervals. Marginal tubercles, of which faint swellings still continue, rib-like, a little on the external part, are at the beginning of the outer whorl connected with the ribs now developed into folds. More anteriorly the fold-like ribs become more and more obscure on the sides, while the marginal tubercles preserve their distinct character.

The external part is flattened in its middle area. From this region, laterally rather sharply bounded, the shell becomes inflated up to the tubercles situated on the margin. This median flattening of the external part is not yet perceptible on the first half of the whorl.

The number of the marginal tubercles present in the circumference of the last whorl amounts to about 15. There is a normal line present.

Siphuncle.—The position of the siphuncle could not be ascertained.

Sutures.—The sutures rather widely separated from one another show a flat external lobe, which is separated from the flat lateral lobe by a broad saddle reaching its greatest height on the margin. The lateral lobe does not reach the depth of the external lobe. A second saddle-shaped curvature of the suture-line is present on the umbilical margin. An internal lobe could not be observed.

Dimensions.—

Diameter	43 mm.
Height of the last whorl	19 „
Thickness „ „ „	21 „
Width of the umbilicus	13 „

Locality and Geological Position.—Carnic Stage; from the lower Daonella beds (Sections 1-2) of the Bambanag Section. Number of specimens examined, 1.

Remarks upon *Pleuronautilus Pichleri*, Hau.—I find myself compelled to expressly declare here that the designation *Pleuronautilus semicostatus*, of Beyrich, must be applied to the specimen described and figured by me under this designation in the "Cephalopoden der mediterranen Triasprovinz," p. 278, Taf. LXXXVI., Figs. 1, 2; for the specimen illustrated in Fig. 2, Pl. LXXXVI., on which the description is based was the original of Beyrich's *Nautilus semicostatus*, which Beyrich described as *Nautilus Pichleri*, Hau., in the year 1867, in the Transactions of the Berlin Academy, and illustrated certainly in a somewhat schematic way (Pl. III., Fig. 4). I did not think it necessary in the description of *Pleuronautilus semicostatus* to mention specially that it was only a question of Beyrich's original to *N. semicostatus* and *N. Pichleri*, though the list of synonyms was in favour of this, and from the statement concerning the proprietorship in the explanation of the plate it was to be understood that the one of the figured specimens belonged to the Berlin Museum.

I feel compelled to make this correction because of the wrong impression which my representation of *Pleuronautilus semicostatus* has given rise to, first by Fr. v. Hauer (Cephalopoden des bosnischen Muschelkalks, Denkschr. Akad. d. Wiss., Wien, 1887, Bd. LIV., p. 15), then by Salomon in his work on the Marmolata (Palæontographica, Bd. XLII., p. 176) and finally just recently by G. v. Arthaber (Cephalopodenfauna der Reiflinger Kalke, Beiträge zur Palæontologie Oesterreich-Ungarns und des Orients, Bd. X., p. 33).

2. PLEURONAUTILUS, f. ind.

This is a fragment of a chambered whorl half of which is calcified. The specimen reminds us of *Pleuronautilus Wulfeni*, Mojs. (Ceph. d. Hallstätter Kalke,

I. Bd., p. 10, Taf. VII., Fig. 3), but it has a less height and greater breadth and wants the characteristic longitudinal striæ in an otherwise similar sculpture.

There is a flat external lobe on the broad external part. A lateral lobe is, on the other hand, scarcely indicated and not so deep as the external lobe. Whether an internal lobe is developed or not could not be observed.

The siphuncle lies at somewhat less than half the height of the whorl.

Locality and Geological Position.—Carnic Stage; in the Daonella beds of Lauka. Number of specimens examined, 1.

B. NAUTILIDÆ.

1.—Nautilus, auctorum.

1.—Nautilus bambanagensis, E. v. Mojs., Pl. XXI., Fig. 1.

The cast provided with the body-chamber consists of three very quickly increasing whorls embracing one another, of which the two outer are higher than wide and have their greatest thickness in the vicinity of the umbilical margin. The external part is rounded. A strong callus closes the umbilicus which is somewhat open in the cast. The innermost whorl which is wider than high has no impression of the internal part, which however is already very distinct in the second whorl.

Siphuncle.—This lies very deep, at a slight distance from the internal part.

Sutures.—The very closely arranged septa describe a flat wide lobe on the sides. An accurate observation of the course of the septa on the external part is rendered difficult owing to the infilling of the chambers having been fractured. An external lobe, however, does not seem to be present, or, should this be there, it is only very slightly developed. An internal lobe is not present.

Dimensions.—

Diameter	135	mm.
Height of the last whorl	87	„
Thickness „ „ „ about	77	„
Width of the umbilicus	0	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

2. Nautilus, f. ind. ex aff. N. mesodici, Pl. XXI., Fig. 2.

This cast chambered throughout shows a great resemblance to *Nautilus mesodicus*, Hau.[1], and has a considerably more concentrated growth. The perforation of the umbilicus, which in *Nautilus mesodicus* amounts to about 12 mm., is in the present cast only 2 mm. There are about one and a half whorls at the diameter of 48 mm. Sharp edges are not yet present at the beginning of the last whorl, but they are formed in the course of the latter. The flattening and the individualisation of the external part occurs simultaneously with the appearance of the marginal angles.

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[1] E. v. Mojsisovics, Cephalopoden der Hallstätter Kalke, I Bd., p. 21, Taf. VIII., Fig. 1.

Siphuncle.—The position of the siphuncle is very deep, near the internal part.

Sutures.—An internal lobe is not present.

The development of the flat external lobe occupying the breadth of the external part goes hand in hand with the appearance of the marginal angles. There is a broad flat lateral lobe at the sides as in *Nautilus mesodicus.* The crowded condition of the septa, which considerably increases towards the anterior fractured edge, is still remarkable. From this increasing shortness of the distance of the septa it must be concluded that the specimen was broken off near the beginning of the body-chamber.

Dimensions.—

Diameter	48	mm.
Height of the last whorl	28	„
Thickness „ „ „	28	„
Width of the umbilicus	4	„

Locality and Geological Position.—Juvavian Stage; of the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 1.

3. NAUTILUS, nov. f. ind.

From the Daonella beds of Lauka there are two crushed specimens of a *Nautilus* which reminds us by its shape and the arrangement of its sutures of *Nautilus haloricus*, Mojs. (Ceph. d. Hallst. Kalke, 1 Bd., p. 20, Taf. VII., Fig. 4), and which is especially distinguished by the fact that the external part seems to be more sharply marked off by blunt angles from the sides.

From its bad state of preservation it would be useless to go more minutely into the description of this undeterminable specimen.

2. CLYDONAUTILUS, E. v. Mojs., Cf. Cephalopoden der mediterranen Triasprovinz, p. 281.

1. CLYDONAUTILUS GRIESBACHI, E. v. Mojs., Pl. XXII., Fig. 1.

This species may be regarded as the precursor of *Clydonautilus biangularis*, for, when it has attained dimensions in which *Clydonautilus biangularis* has already reached its characteristic features, it is still in a stage of development which characterizes the latter in the adolescent stage.

The penultimate whorl of the figured specimen still possesses an inflated external part, which is not separated from the sides even by the indication of an angle but merges into the sides with a continuous swelling.

At the beginning of the last whorl, which is chambered throughout, there are faint rounded angles forming the boundaries of the still inflated external part. These angles are still more conspicuous up to the anterior end of this whorl.

The greater breadth of the external area and the greater thickness of the whorls may be further mentioned as distinguishing features in contrast to *Clydonautilus biangularis*. As to the form of the umbilicus, a decided opinion as to whether it was open or closed by a callus, cannot be arrived at owing to the bad state of preservation. It has however the appearance as if the umbilicus were somewhat open.

Siphuncle.—Its position seems to be the same as in *Clydonautilus biangularis.* But perfectly correct observation was unfortunately not possible.

Sutures.—The mode of development of the suture-line is about the same as in *Clydonautilus biangularis,* with the remarkable difference, however, that a division of the external lobe by a flat median projection never occurs here. Furthermore the external saddle is in *Clydonautilus Griesbachi* at the anterior end of this fragment just at the rounded marginal angle, while in shells of the same dimensions of *Clydonautilus biangularis* the external saddle is seen to be shifted to the sides.

The great width of the lateral lobe is further very noteworthy, this being due to the fact that the top of the lateral saddle is only on the umbilical margin. The penultimate whorl shows the flat sinuosity of the external lobe in the completely rounded external part which is not yet individualized. There is no internal lobe.

Dimensions.—

Diameter	86	mm.	
Height of the last whorl	54	„	(cast)
Thickness „ „ „	44	„	
Width of the umbilicus	2·5	„	(cast)

Locality and Geological Position.—Juvavian Stage; in the Limestone complex (No. 6) with *Pinacoceras* cf. *imperator* of the Bambanag Section. Number of specimens examined, 1.

2. Clydonautilus biangularis, E. v. Mojs., Pl. XXII., Figs. 2, 3.

The shell distinguished by an umbilicus closed by a callus has a narrow external part, which is not defined by lateral angles, and is completely smooth and flattened. The sides converge towards the external part. The shell reaches its greatest breadth outside the deep umbilicus, in the region of the lateral saddle. The whorls are moreover higher than wide. An umbilical margin is not present, but the shell descends in a curve from the greatest lateral inflation in the region of the lateral saddle to the umbilicus which seems to be open on the casts.

The sculpture consists of flat, more or less conspicuous folds, which on the sides undergo an anteriorly convex curvature and continue in a lessening degree over the flattened external part. Coarser fold-like striæ are also observed in some specimens parallel to these folds, especially on the upper half of the sides.

The normal line in the middle of the external part is present on the chambered portions of the shell as well as on the body-chambers of the casts.

Internal casts have a rounded external part. The two marginal angles make their appearance simultaneously with the flattening and the individualisation of the external part only at a diameter of about 16 mm.

It is worthy of note that there are several examples of body-chambers of very different dimensions in the present material. The last septa are not wide apart in these specimens, so that probably immature individuals in the different stages of growth may be present. The largest specimen is chambered throughout at a diameter of 100 mm.

Clydonautilus biangularis is very closely related to *Clydonautilus Quenstedti*, Hau., from the middle Juvavian Hallstatt Limestone, but is distinguished from this by the umbilicus being closed by a callus and by the crossing of the external part by the radial folds.

Siphuncle.—The orifice of the siphuncle, elliptically elongated in the direction of the radius, is somewhat above the middle of the distance between the external parts.

Sutures.—Besides the flatly arched lateral lobe there is on the sides in the young only an auxiliary lobe present and the septa pass uncurved over the external part. Almost simultaneously with the appearance of the external angles a gentle anteriorly concave curvature of the septum is formed on the external part which gradually changes into an external lobe increasing in depth. The external saddle thus simultaneously arising shifts gradually from the external angle to the sides and becomes finally individualised into a round pointed saddle top which is followed by the very deep rounded large lateral lobe.

The lateral saddle which separates the lateral lobe from the auxiliary lobe, falling into the umbilical suture, is broadly rounded above.

Another modification occurs in the external lobe at a more advanced stage of growth. Its centre rises into a flat undulation so that a kind of very low but broadly spread and broadly inflated median projection results, which according to the analogy of the Ammonite sutures separates the external lobe into two halves. An internal lobe is not present.

Dimensions.—

Diameter	80	mm.
Height of the last whorl	51·5	„
Breadth „ „ „	40	„
Width of the umbilicus	0	„

Locality and Geological Position.—Juvavian Stage; in the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 8.

3. CLYDONAUTILUS, nov. f. ind.

There is a fragment of a *Clydonautilus* from the Daonella beds of Lauka which is distinguished from *Clydonautilus Griesbachi*, to which it is closely allied, by the greater inflation of the external part which is bordered at the sides by blunt angles. Faint transverse folds, similar to those of *Clydonautilus biangularis*, are present on the sides.

The suture-line, of which the external lobe as well as the greater part of the deep-lateral lobe are to be seen, shows great resemblance to *Clydonautilus Griesbachi*.

C. ORTHOCERATIDÆ.

1. ORTHOCERAS, Breynius.

Orthoceras, f. ind., Pl. XXI., Fig. 5.

Representatives of the genus *Orthoceras* are extremely rare in the upper trias of the Himálaya. The few fragments present are only sufficient to determine the genus. It is out of the question to attempt to name the species. The fragment figured is a cast of a body-chamber and comes from the Halorites-Limestone of the Bambanag Section.

DIBRANCHIATA.

AULACOCERATIDÆ.

1. ATRACTITES, Gümbel.

1861. *Atractites*, Gümbel, Geogn. Beschreibung des bayerischen Alpengebirges, p. 475.
1882. *Atractites*, E. v. Mojs., Cephalopoden der mediterranen Triasprovinz, p. 299.

ATRACTITES, f. ind., Pl. XXI., Fig. 4.

Among the material available from the upper trias of the Himálaya *Atractites* is, it is true, somewhat less rare than *Orthoceras*, but nevertheless is not of frequent occurrence.

The present fragments cannot serve for the establishment of the species.

The figured phragmocone has a divergent angle of 11·5°.

The transverse section is circular. The distance between the septa amounts to somewhat less than half the diameter of the inferior septum.

The surface of the shell shows coarse but faint and indistinct transverse striæ on the ventral side, while the dorsal side appears to be completely smooth.

There are no rostra present.

Locality and Geological Position.—Juvavian Stage; in the Halorites-Limestone of the Bambanag Section. Number of specimens examined, 10 fragments of phragmocones.

RESULTS.

The forms described in this work are grouped, on the basis of the stratigraphical data supplied by Dr. Diener, into four faunæ, to which is added, as a fifth, the fauna of the *Tropites* Limestone of Kalapani collected by Griesbach. In order to give as complete a picture as possible of each fauna the few specimens, which on account of imperfect preservation, could not be described, are catalogued in the following lists, besides the species mentioned in the text.

1. Carnic Stage.

1. The lowest division of the Tyrolese Series, in the section of Rimkin Paiar immediately succeeding the Anisic Stage, is formed by the dark grey Limestone with *Traumatocrinus*, sp. (=*Porocrinus*, v. Dittmar).[1]

The Cephalopoda-bearing dark grey limestone, designated by Griesbach as the "Horizon of *Ammonites Aon*" of the Ralphu Glacier, in the valley of the Lissar river, belongs to the same horizon.

As is seen from the identity of some of the fossils, part of the Ammonites of the Niti Pass described by Salter come from the same group of beds.

There are, on the whole, twelve forms known up to the present time from this horizon, *viz.*:—

1. *Isculites*, cf. *Heimi*, (Rimkin Paiar).
2. *Eutomoceras*, nov. f. cf. *C. Plinii*, (Rimkin Paiar).
3. *Arpadites Stracheyi*, (Niti Pass).
4. „ *rimkinensis*, (Rimkin Paiar).
5. „ *lissarensis*, (Ralphu Glacier).
6. *Protrachyceras ralphuanum*, (Ralphu Glacier).
7. „ f. ind., (Ralphu Glacier).
8. *Trachyceras tibeticum*, (Rimkin Paiar).
9. „ f. ind., (Group of *duplica*, Niti Pass).
10. *Joannites* cf. *cymbiformis*, (Rimkin Paiar, Ralphu Glacier).
11. *Ptychites posthumus*, (Ralphu Glacier).
12. *Hungarites nitiensis*, (Rimkin Paiar, Niti Pass).

Having regard to the character of the rock the dark grey limestone of Tera Gadh, north of Kalapani, labelled by Griesbach "Lower Trias, bed 2," may also be included in the horizon of the Crinoidal limestone of Rimkin Paiar. The Ammonites from Tera Gadh are as follow:—

1. *Thisbites* (?) *meleagri*.
2. *Placites*, f. ind.
3. *Arcestes subbicornis*.

It must be remarked, with reference to these lists, that the products of the above localities are very meagre. It is nevertheless easy to see at a glance that we have to deal here with a Carnic fauna. On the other hand it is less easy to decide whether we may designate the fauna as Cordevolic or Julian. In favour of the Cordevolic period might be mentioned the occurrence of some ancient types, such as *Ptychites* and *Hungarites*. It might also result from the fact that the Daonella beds, succeeding the Crinoidal limestones, must decidedly be assigned to the Julian period, that the Crinoidal limestones must belong to the next lower zone of *Trachyceras Aon*.

In the Mediterranean Province the earliest known *Ptychites* come from the Fassanic lower stage and the earliest *Hungarites* from the Longobardic, and the occurrence of these two genera in the Carnic deposits of the Himálaya must therefore be regarded as a very remarkable phenomenon. The question might therefore be raised as to whether the localities may not have been confounded. Against this I may state that *Ptychites posthumus* was worked out by myself from a hand-specimen containing *Joannites* cf. *cymbiformis*, and that further *Hungarites nitiensis* was likewise lately obtained in Vienna from the Crinoidal limestone of Rimkin Paiar. The fact is therefore not to be disputed that the two forms come from the same rocks as the rest of the fauna given above, and if the character of fauna taken as a whole points to the Carnic age, we must for the Indian trias Province regard the case as proved that the genera *Ptychites* and *Hungarites* ascend in this province to the Carnic stage. Both genera are represented by forms of very small size and concentrated growth; we lay a stress upon this circumstance, because the observation already frequently made by us that concentrated[1] types of small size are to be regarded as senile moribund phenomena acquires a new confirmation. The occurrence of a *Hungarites* in a Carnic horizon seems, however, less surprising if we remember that the genus *Carnites*, descending[2] from *Hungarites* first occurs in the Julian deposits. The more developed indentation of the sutures, moreover, distinguishes *Hungarties nitiensis* from the older species and is in harmony with the later age of this species.

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[1] Wöhrmann, Jahrb Geol. R. A. 1889, p. 190.

If we now pass on to the consideration of the rest of the fauna, we find in it a predominant number of genera which are on the whole characteristic of the Carnic stage and a smaller number which are especially so of the Julian sub-stage. To it belong the genera *Trachyceras*, *Thisbites*, *Eutomoceras*, *Isculites*, *Arcestes* and *Placites*. The genus *Trachyceras* occurs in Europe for the first time in the upper region of the Longobardic stage, but only becomes an important factor in the Cordevolic fauna. The five other genera appear in Europe for the first time in the Julian deposits. But not only the agreement of the greater number of the genera but also the specific relationship of some forms speak for the Julian age of our fauna. In the first place we mention *Joannites* cf. *cymbiformis*, and *Trachyceras tibeticum*, which latter species is so closely related to *Trachyceras Austriacum* that it may be regarded as a geographical variety of it. *Isculites* cf. *Heimi* is next to be mentioned, which diverges only a little from the European type. In the rest of the genera the relationships to Julian species and even, as in *Arcestes subbicornis*, to Tuvalic, prevail likewise. *Arpadites*, on the other hand, belongs to types which are peculiar to the Indian trias Province.

If we summarize the above observations we come to the conclusion that the Crinoidal limestone of Rimkin Paiar and the limestones of Niti Pass, Ralphu Glacier and Tera Gadh, which are on a similar horizon, are to be regarded as homotaxial with the Julian stage[3] and not with the Cordevolic.

2. From the Daonella beds overlying the Crinoidal Limestone of Rimkin Paiar

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[1] An analogous case is formed by the dwarf-like Ceratites of concentrated growth which are found in the same horizon in the Julian limestone of the Salzkammergut.

[2] Compare the ontogenetic development of *Carnites*. Cephalopoden d. medit. Triasprovnz, p. 228.

[3] Also the genus *Traumatocrinus* must be regarded as typical of the Julian stage, as it was up to the present time known in Europe only in the Cardita beds of northern Tyrol and in the Julian limestone of Hallstatt.

cephalopods have been obtained from several localities, but these unfortunately leave much to be desired with reference to their state of preservation. According to Dr. Diener's verbal communications the cephalopods are not rare in this thick mass of beds, but it is very difficult to secure them owing to their fragility. The localities in which they have been found are named in the following list. The numbers, it must be mentioned, indicate the position within this complex of beds, No. 1 marking the lowest and No. 5 the highest position.

1. *Jovites*, ind. ex aff. *J. daci*, (No. 2, Rimkin Paiar).
2. *Eutomoceras*, n. f. cf. *E. Plinii*, (No. 1, Rimkin Paiar).
3. *Anatomites bambanagensis*, (Bambanag).
4. „ *Eugenii*, (Rimkin Paiar).
5. „ *Caroli*, (Rimkin Paiar).
6. *Griesbachites Medleyanus*.
7. „ *Hanni*, (Lauka, No. 4, Bambanag).
8. *Juvavites*, f. ind., (Kiangur Section).
9. *Sagenites*, n. f. ind., (No. 2. Bambanag).
10. *Styrites* f. ind., (No. 1, 2, Bambanag).
11. „ f. ind., (No. 1, 2, Bambanag).
12. *Tibetites*, f. ind., (upper division in the Bambanag Section).
13. *Proarcestes*, n. f. ind., (Lauka, Bambanag).
14. *Cladiscites* (*Hypocladiscites*) *subaratus*, (Lauka).
15. *Paracladiscites indicus*.
16. „ n. f. ind.
17. *Megaphyllites* ind. (Utadurrha Pass).
18. *Placites*, ind. ex. aff. *Pl. peraucti*, (Bambanag).
19. „ *Oldhami*, (Lauka).
20. *Mojsvárites eugyrus*, (No. 5, Bambanag, Kiangur).
21. „ (*Phylloceras*) *Ebneri*, (Lauka).
22. *Pleuronautilus tibeticus*, (No. 1, 2, Bambanag).
23. „ ind., (Lauka).
24. *Nautilus*, n. f. ind., (Lauka).
25. *Clydonautilus*, n. f. ind., (Lauka).
26. *Orthoceras*, f. ind., (Bambanag, Utadurrha Pass).

This fauna also bears the stamp of the Julian age as shown by the genera which it contains as well as by the relationship of its species to European ones. The beds with *Lobites ellipticus* of the Feuerkogel on the Röthelstein, near Aussee, especially show a very striking similarity to this fauna. Among these similar forms I count *Anatomites*, *Griesbachites*, *Styrites*, *Cladiscites* and *Paracladiscites*, the last of which is represented by two species perhaps identical with the European ones.

Anatomites shows the closest relationship with species of the beds with *Lobites ellipticus*, and it is the same with *Styrites*. *Griesbachites* may be regarded as an Indian type which has become known in Europe only as a great rarity in the beds with *Lobites ellipticus*. The genus *Tibetites* which represents the Mediterranean genus *Cyrtopleurites* in the Indian province appears in the Daonella beds for the first time. *Cyrtopleurites* occurs correspondingly for the first time also in beds with *Lobites ellipticus*. *Mojsvárites eugyrus* which comes from the uppermost division of the Daonella beds is found in Europe not only in beds with *Lobites ellipticus* but also in the zone of *Tropites subbullatus*.

As is known, certain subdivisions are to be recognized in the Julian limestone of Hallstatt (beds with *Trachyceras austriacum*, beds with *Lobites ellipticus* and beds with *Trachyceras Aonoides*) to which I have as yet attached no chronological significance on account of their close faunal relationship.[1]

The fauna of the Daonella beds only shows the character of the composition of the fauna of the beds with *Lobites ellipticus* without any foreign elements; while the Crinoidal limestone with *Trachyceras tibeticum*, as well by its lower stratigraphical position as by the admixture of older types (*Ptychites*, *Hungarites*), seems to possess a somewhat greater age, and may be regarded as a lower division of the Julian stage homotaxial with the beds with *Trachyceras austriacum*.

3. In this place the fauna of the Tropites limestones of Kalapani might be discussed; but the limestones could not unfortunately be found again in the sections closely examined by Diener and Griesbach. The uppermost layers of the Daonella beds with *Mojsvárites eugyrus* probably correspond with the Tropites limestone, or else no sediment has been deposited at all in this region of the Himálaya during the Tuvalic period. It cannot at present be decided whether it is here a question of deficiency in our knowledge of the subject or of an absence of sediments.

The fauna, unfortunately badly preserved, consists of the following forms:—

1. Jovites, nov. f. ex. aff. *J. bosnensis*.
2. „ cf. *dacus*.
3. *Tropites kalapanicus*.
4. „ nov. f., cf. *T. acutangulus*.
5. „ nov. f. ind.
6. „ ind., cf. *T. fusobullatus*.
7. „ ind., cf. *discobullatus*.
8. *Eutomoceras*, ind., cf. *E. sandlingense*,
9. *Sagenites*, ind., cf. *S. inermis*.
10. *Trachyceras*, n. f. ind.

The crinoid-bearing red limestone of Kiogarh Range, south of Sangcha Tálla, in the cliff region, from which we have four specimens of *Jovites*, probably belongs also to the horizon of the Tropites limestone of Kalapani, for the specimens of *Jovites* seem to agree with the new species, mentioned above under No. 1. I consider the Tropites limestones of Kalapani as the exact homotaxial equivalent of the Tuvalic Tropites limestones of the Mediterranean Province. There exists in both cases not only the same association of genera, but also close specific relationship, which in a better state of preservation of the specimens might perhaps have led to the identification of some forms with European species.

The genus *Trachyceras* which does not appear any more in this high horizon in the Mediterranean Province forms the only foreign element of the fauna in the Tropites limestone of Kalapani. According to the account given by J. Perrin Smith,[1] *Trachyceras* is, however, also found in the Tropites beds of California, also Tuvalic. It therefore seems that the genus *Trachyceras* which appears in Europe for the last time in the Julian deposits has withdrawn during the Tuvalic period towards the east of the Thetys and into the Pacific basin.

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[1] Cephalopoden der Hallstätter Kalke, II. Bd., p. 793.

II. Juvavian Stage.

1. A complex of nodular and slaty limestones which in the labels before me is marked No. 6, and is in Dr. Diener's report designated "Hauerites beds," succeeds the Daonella beds in the Bambanag section. With the small number and the bad state of preservation of the present cephalopoda it is difficult to find a suitable name for this division.

The small fauna consists of the following forms:—

1. *Parajuvavites*, n. f. ind. (ex. aff. *P. Jacquini*).
2. „ n. f. ind.
3. *Juvavites*, ind.
4. *Sagenites*, n. f. ind.
5. *Hauerites* (?), n. f. ind.
6. *Arcestes*, n. f. ind.
7. *Pinacoceras*, ind., (Group of *Pin. imperator*).
8. *Clydonautilus Griesbachi*.

The Juvavian type of the fauna shows itself immediately and indubitably in these few remains in spite of the great deficiency of the material. *Parajuvavites* especially plays an important part in the division of the beds that follow and are represented here by two different species; then we have *Arcestes*, comparable to the Lacic *Arcestes syngonus*; *Pinacoceras*, which reminds us very much of *P. imperator;* and *Hauerites*, all of which give the Juvavian impress to the fauna.

I consider the suggestion that this fauna might be added to the following fauna of the Halorites limestone must be put aside for the reason that not one of the numerous species of the Halorites limestone is present. *Clydonautilus Griesbachi*, which is probably the immediate ancestor of *Clydonautilus biangularis* and therefore belongs, with this species, to the same genetic series of forms, leads to the conclusion that the fauna, of which it is a constituent part, must be older than the fauna which has its descendants as contemporaries.

The faunal guides are not sufficient for a more exact determination of the age. But from the investigation into the age of the Halorites limestone it results that the fauna of the complex of beds No. 6 might be regarded as an homotaxial equivalent of the lower division of the Lacic lower stage.

2. By far the richest among the upper triassic cephalopoda faunæ investigated

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[1] The metamorphic Series of Shasta County, California, Journ. of Geology, vol. II., p. 607. Mesozoic Changes in faunal Geography of California, Journ. of Geology, vol. III., p. 377.

is that of the Halorites limestone, of which the greater part originates in the Bambanag section. Names of localities are therefore added in the following list only where the species in question originate from other localities:—

1. *Halorites procyon.*
2. „ *Sapphonis.*
3. „ *Charaxi.*
4. „ *Phaonis.*
5. „ *Alcaei.*
6. *Parajuvavites Blanfordi.*
7. „ *laukanus,* (Lauka).
8. „ *Sternbergi.*
9. „ *Feistmanteli,* (also in Rimkin Paiar).
10. „ *Jacquini.*
11. „ *Tyndalli.*
12. „ *Renardi.*
13. „ *Ludolfi.*
14. „ *minor.*
15. „ *Brintoni.*
16. „ *Buddhaicus.*
17. „ *Stoliczkai.*
18. „ n. f. ind.
19. *Thetidites Guidonis.*
20. „ *Huxleyi.*
21. *Guembelites jandianus,* (Jandi Pass).
22. *Anatibetites Kelvini,* (also in Rimkin Paiar).
23. „ n. f. ind.
24. *Tibetites Ryalli.*
25. „ *Murchisoni.*
26. „ *Perrin-Smithi.*
27. *Paratibetites Bertrandi.*
28. „ *Geikiei.*
29. „ *Adolphi.*
30. „ *angustosellatus.*
31. „ *Tornquisti.*
32. *Helictites Atalanta.*
33. *Dittmarites Hindei.*
34. *Dionites,* ind., cf. *D. Asbolus.*
35. *Steinmannites Desiderii.*
36. „ *clionitoides.*
37. „ *Noetlingi.*
38. „ *undulatostriatus.*
39. „ *Lubbocki.*
40. *Clionites Woodwardi.*
41. „ *Salteri.*
42. „ *aberrans.*
43. „ *spinosus.*
44. „ *Hughesi.*
45. „ n. f. ind.

46. *Sirenites Richteri.*
47. „ *elegans.*
48. „ n. f. ind.
49. *Sandlingites Nicolai.*
50. „ *Archibaldi.*
51. *Arcestes Leonardi.*
52. *Pinacoceras parma.*
53. *Bambanagites Schlagintweiti.*
54. „ *Dieneri.*
55. *Placites Sakuntala.*
56. *Nautilus bambanagensis.*
57. „ n. f. ex. *aff. N. mesodici.*
58. *Clydonautilus biangularis.*
59. *Orthoceras*, f. ind.
60. *Atractites*, f. ind.

Notwithstanding the rather considerable local peculiarities, the typical Juvavian habit of this fauna is very striking, and it therefore seems to us superfluous to further discuss the distribution in the Juvavian stage. The analysis will therefore be confined exclusively to the emphasizing of the local features and the more exact determination of the age.

Halorites and *Parajuvavites*, both of which genera give to the fauna a type peculiar to it, are conspicuous for their fecundity. *Halorites* is exclusively represented by acatenate species with externally rounded peristome, while in the acatenate Mediterranean species the peristome is as a rule rectangular. Acatenate forms with externally rounded peristome are only very rarely found in the Hallstatt limestone; they may be designated as Indian elements. The new genus *Parajuvavites* is in its typical representatives confined to India. A closely agreeing form has however been known as a rarity in the Lacic Hallstatt marble of Leisling, near Goisern, but it is distinguished from its Indian congeners by having uninterrupted external ribs. The Sibirites genus *Thetidites* is confined to India. The representative genus *Metasibirites* occurs in the Lacic deposits of the Mediterranean Province. Another genus peculiar to the Indian Province is *Tibetites*, with the sub-genera *Anatibetites* and *Paratibetites*. *Tibetites* is replaced in the Mediterranean Province by the allied genus *Cyrtopleurites*. Exclusively Indian types which have no representatives in the Mediterranean Province are *Guembelites* and *Bambanagites*.

A highly interesting type is formed in the Indian Province by the group of *Steinmannites undulatostriati*, which I have recently collected in a species not yet described in the Lacic Hallstatt marble with *Sagenites Giebeli*. *Clionites*, which is as frequent in India as *Steinmannites*, comes nearest to an upper Lacic form[1] from the group of *Clionites Ares*. The genus *Dionites* is represented in our Indian fauna by a fragment which comes very near to *Dionites Asbolus* and is perhaps even identical with it.

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[1] Clionites n. f. ind. ex. aff. *Cl. Ares*, Cephalopoden der Hallstätter Kalke, II. Bd., p. 479, Taf. CXLIV, fig. 3,

The group of *Sirenites Argonautæ* is represented by two species, one of which, *viz.*, *S. Richteri*, comes very near the Lacic *S. Evæ*; while the other, *S. elegans*, recalls the Alaunic *S. Stachei*. *Sandlingites* is closely related to the upper Lacic *Sandlingites Reyeri*. *Arcestes Leonardi* comes nearest to the upper Lacic *Arcestes biceps*. The genus *Pinacoceras* is represented by the species *P. parma* occurring in the upper Lacic and the Alaunic Hallstatt limestone. *Placites Sakuntala*, an independent Indian type, seems to be related to the upper Lacic *Placites polydactylus* *Clydonautilus biangularis* reminds us of the Alaunic *Clydonautilus Quenstedti* while an unknown new *Nautilus* recalls *N. mesodicus*.

The cephalopod fauna of the Halorites limestone has, as the above analysis shows, relations with both the Alaunic and the Lacic fauna. It remains therefore to investigate whether there is an equal distribution of the fauna in both, or whether there is a preponderance of it in one of them.

The opinion might be expressed that the occurrence of the genus *Tibetites*, which represents *Cyrtopleurites*, points to the Alaunic sub-stage, as from the Lacic deposits of the Mediterranean Province *Cyrtopleurites* is not yet known, whilst the Alaunic fauna comprises most representatives of this genus. It must on the other hand be remembered that the genus *Cyrtopleurites* occurs already in typical species in the Mediterranean Province during the Julian period. The apparent intermittence during the Lacic period has therefore no great significance and may be annulled by fortunate discoveries.

The circumstance that the acatenate *Halorites* with externally rounded peristome has up to the present time been stated to occur only in the Alaunic fauna of the Mediterranean Province, can be brought forward just as little in favour of the recognition of an Alaunic age, for the rather frequent occurrence of acatenate *Halorites* in the Lacic Hallstatt limestone gives rise to the supposition that it is perhaps only a matter of chance that such Indian *Halorites* types have not also been found in the Lacic Hallstatt limestone.

The specific similarities to Alaunic species—putting aside *Pinacoceras parma*, a species known to be Lacic as well as Alaunic—are rather infrequent in the fauna of the Halorites limestone and are confined to *Sirenites elegans* and *Clydonautilus biangularis*, while a greater number of relationships and analogies speak in favour of the Lacic age.

The discovery, above mentioned, of an undulatostriate *Steinmannites* in the Lacic Hallstatt limestone is to be referred to in the first place. The occurrence of the genus *Parajuvavites*, which is confined to the Lacic stage of the Hallstatt limestone, is also of some significance; so is the limitation of the genus *Metasibirites* to the Lacic deposits. We have further to refer to the specific similarities to *Helictites Atalanta*, *Dionites* cf. *Asbolus*, *Sirenites Richteri* and *Arcestes Leonardi*, as well as to the close relationship of *Clionites* to a Lacic species of the Mediterranean Province and of *Sandlingites* to the Lacic *Sandlingites Reyeri*.

The relationship to the Lacic stage is, as can be easily seen, manifold. There is still, however, a further consideration which leads to the conclusion that the Halorites limestone is to be assigned to the Lacic stage. The Halorites limestone is wanting in all the elements which are, according to present knowledge, confined to the Alaunic stage and of which they are characteristic.

From the establishment of the Lacic age for the Halorites limestone it results that the above-mentioned complex of beds, No. 6, with *Clydonautilus Griesbachi*, underlying the Halorites limestone, is to be regarded as a lower division of the Lacic stage. As in the Mediterranean Province two closely related Lacic faunæ, the zones of *Sagenites Giebeli* and of *Cladiscites ruber*, can be distinguished, so also in the Indian Province two Lacic zones could be supposed to exist, *i.e.*, the still incompletely known lower zone of *Clydonautilus Griesbachi* and the upper zone of *Steinmannites undulatostriatus*.

3. The cephalopoda-bearing beds in the parts of the Himálaya best known up to the present time terminate with the Halorites limestone. Only from the "Sagenites beds," so named by Dr. Diener, which are separated from the Halorites limestone by the limestones and dolomites (100—120 m. thick) with *Spiriferina Griesbachi*, Bittn., there is an imperfect fragment of a *Sagenites* related to *Sagenites quinquepunctatus*. Such forms extend in the Mediterranean Province to the Sevatic stage.

Could one see in the beds with *Spiriferina Griesbachi* a deposit homotaxial with the Alaunic sub-stage, the bivalve beds, 30-40 m. thick, with *Sagenites* might already be of Sevatic age. In this case the limestone and dolomites, designated as "Dachstein Kalk" at the top of the "Sagenites beds," might well be regarded as at least partly representing the Rhætic stage, but it must not be ignored that lower Jurassic (Liassic) horizons might also be contained in them.

Break in the succession of the beds.—The following table, which extends from the overlying Liassic boundary to the underlying boundary between the Dinaric and the Scythian series, will clearly show the stratigraphical position which the cephalopoda-bearing upper triassic deposits which are more minutely dealt with in the present work occupy. It becomes clear from this table that at least according to the present state of our knowledge there seems to exist a great hiatus in the succession of deposits in the parts of the Himálaya more closely examined up to the present time, a hiatus that corresponds to the duration of the Cordevolic, Longobardic and Fassanic periods. This hiatus agrees in a remarkable manner, as Diener has already mentioned, exactly with the hiatus which seems to exist in our north-eastern Alps. Only recently it was still considered to be an established fact that in this part of the Alps the zone of *Trachyceras Aonoides* lay directly on the beds with *Ceratites trinodosus*, though there were those who supported the opinion that the Reifling limestones must represent not only the Anisic stage but also the zones (apparently wanting, and the existence of which cannot be proved on palæontological grounds) extending upwards to the *Aonoides* zone. Dr. G. v. Arthaber[1] who with great zeal and success devotes himself to the study of the typical Reifling limestone of Reifling has now actually succeeded in finding palæontological support for the recognition of the representation of the Fassanic and Longobardic faunæ in the upper part of the Reifling limestone.

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[1] Verh. geol. R. A., 1896, p. 124.

Series.	Stages.	Sub-stages.	Zones in the Mediterranean Province.	Indian Province.
BAJUVARIAN.	Rhætic	Rhætic	22. Zone of *Avicula contorta*	? ↑ Hochgebirgskalk?
	Juvavian.	Sevatic	21. Zone of *Sirenites Argonautæ*. 20. Zone of *Pinacoceras Metternichi*	"Sagenites beds"?
		Alaunic	19. Zone of *Cyrtopleurites bicrenatus*	Beds with *Spiriferina Griesbachi*?
		Lacic	18. Zone of *Cladiscites ruber*	Zone of *Steinmannites undulatostriatus*.
			17. Zone of *Sagenites Giebeli*	Zone of *Clydonautilus Griesbachi*.
TYROLEES	Carnic.	Tuvalic	16. Zone of *Tropites subbullatus*.	Tropites Limestone of Kalapani.
		Julian	15. Zone of *Trachyceras Aonoides*	1. Daonella beds with *Griesbachites Hanni*. 2. Crinoidal Limestone with *Trachyceras tibeticum*.
		Cordevolic	14. Zone of *Trachyceras Aon*	Break in the succession of sedimentary deposits.
	Noric.	Longobardic	13. Zone of *Protachyceras Archelaus*	
		Fassanic	12. Zone of *Dinarites avisianus*. 11. Zone of *Protrachyceras Curionii*	
DINARIC.	Anisic.	Bosnian	10. Zone of *Ceratites trinodosus*	Zone of *Ptychites rugifer*.
		Balatonic	9. Zone of *Ceratites binodosus*	Zone of *Sibirites Prahlada*.
	Hydaspic	Hydaspic	?	8. Zone of *Stephanites superbus* (Salt Range).

Dr. A. Bittner[1] could also in a number of places in upper Steiermark and lower Austria, in the border region between the Reifling limestone and the *Halobia rugosa* slates, prove the presence of the Brachiopoda of the so-called Partnach beds, which lie in the regions of the Wendelstein and Füssen between the Anisic stage and the Wetterstein limestone, and which has been wrongly placed by a number of recent authors on the same horizon as the St. Cassian beds. Without entering here into a discussion about the probable horizon of these Partnach beds which are either directly overlaid by the *Halobia rugosa* slates or by the Wetterstein limestone, I should like to mention here as characterising the great hiatus[1] in the succession of beds, occurring in places, that in the Salzkammergut the Sevatic Zlambach beds lie in some places above the Anisic stage. In this latter case not only the two lower divisions of the Juvavian stage are wanting, but also the whole of the Tyrolese series. I should not therefore like to attach any great importance to the hiatus in the Himálayan trias section, but only see in it a repetition of a phenomenon known to Alpine geologists. The expectation may therefore be indulged in that fortunate discoveries may lead to the filling up of such a hiatus by further investigations in the Asiatic mountains.

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[1] Verh. geol. R. A., 1896, p. 18.

Also the absence of the Tropites limestones of Kalapani in the sections, so carefully studied by Griesbach and Diener, of the Shalshal cliff near Rimkin Paiar and the Bambanag cliffs in the Girthi Valley might be regarded as an argument in favour of the local nature of the hiatus, if the hiatus in question should turn out to be a real one.

The Indian Trias Province.—There is no occasion to explain further that the upper triassic faunæ of the Himálaya here described bear quite a distinct local character which distinguishes them from the homotaxial faunæ of the Mediterranean Province. Nevertheless there can be no doubt of the former existence of an open connexion of the sea between the two regions. The Mediteranean Province is the most westerly extension of the Thetys, so called by Ed. Suess, the great Trias sea, which, occupying the place of the present Asiatic mountains, extended from the Mediterranean gulf in a west-easterly direction to the great Pacific Ocean. Were the continuous connexion between the Mediterranean gulf and the Indian part of this Thetys, with its faunal contents, known to us, the contrast between the Mediterranean and Indian faunæ would probably be less abrupt and the faunæ of the middle portion for the greater part still unknown would show a gradual transition between the widely remote western and eastern regions of the Thetys, which we now designate as Mediterranean and Indian Trias Provinces.

The preponderance of *Trachyostraca* with the simultaneous diminution of *Leiostraca* is one of the most striking peculiarities of the upper triassic cephalopod faunæ of the Indian Province. We shall only refer here to the remarkable rarity and the small number of species of *Arcestes* and to the only quite isolated occurrence of the genus *Megaphyllites*. *Arcestes* and, in certain deposits, also *Cladiscites* and *Megaphyllites* play, as is known, an important part, in the Mediterranean Trias Province; but their occurrence is chiefly confined to limestone formations, poor in clay, as I mentioned years ago;[2] while also in the Mediterranean Province deposits richer in clay, as for instance, the Wengen and St. Cassian beds, show a predominance of *Trachyostraca*. It might therefore be supposed that the diminution of *Leiostraca* in the upper triassic deposits of the Himálaya may be connected with their clayey contents. This may be the case to a certain degree, especially in the Daonella beds; but it seems as if the character of the facies would not alone be sufficient to explain the rarity of the occurrence of *Leiostraca* in the upper trias of the Himálaya. It is particularly striking that in spite of the small number of cephalopoda from the Crinoidal limestone with *Trachyceras tibeticum* the genus *Joannites* occurs rather frequently among them.

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[1] Cf. Ueber den chronologischen Umfang des Dachsteinkalkes. Sitzungsber, Bd. CV., Abth. I., p. 11.

[2] Cephalopoden der Medit. Triasprovinz, pp. 152, 312, 315.

The Halorites limestone with *Steinmannites undulatostriatus* might not essentially differ with reference to the clayey contents from the Crinoidal limestone with *Trachyceras tibeticum*; nevertheless the Leiostracan Ammonites in them are amongst the greatest rarities. It therefore seems that this phenomenon is not to be explained by the peculiarity of the facies, but by the conditions of the geographical distribution.

It is noteworthy that *Cladiscitidæ*, *Megaphyllites* and *Phylloceras* in the Himálaya have only been found in beds of Carnic age and seem to be wanting in the Juvavian deposits. The genus *Stenarcestes* of the family Arcestidæ has not been found in the Himálaya up to the present time; but it appears associated with *Phylloceras* from the group of *P. neojurense* in the trias of New Caledonia, from which it may be concluded that it might not have been foreign to the Thetys. The upward extension of the genera *Ptychites* and *Hungarites* into the Julian faunæ, already minutely discussed, forms a peculiarity of the Indian Province.

With reference to Trachyostraca the considerable numerical preponderance of the Dinaritidæ and Haloritidæ must be taken into account. The Tropitidæ are confined to the Carnic stage, and do not seem to be very numerous. The Tirolitidæ belong to types which occur sporadically and are therefore rare.

The Dinaritidæ belong, as was already shown[1] some time ago, to the most characteristic types of the Arctic-Pacific and the Indian Trias Provinces.

They form there with the exception of the completely wanting Tirolitidæ the only representatives of the Ceratitoidea. The new and important monographs of Waagen and Diener on the cephalopoda of the Scythian and Dinaric series have fully corroborated the validity of this classification of the Indian Province.[2] The Tirolitidæ are in accordance with our present knowledge to be regarded as specific Mediterranean types which have branched off during the Scythian period in the Mediterranean Province and have become independently developed within this Province.

Some rare representatives of Trachycerata belonging to the genetic series of Tirolitidæ appear now suddenly quite sporadically during the Carnic period in the Indian seas (Noric deposits, as mentioned above, have not yet been proved to exist in the Himálaya), and a few rare types of the same family (*Sirenites* and *Sandlingites*) also during the Lacic period surprise us. If this sporadic occurrence of a stock unknown before in the Indian seas points to a migration from distinct seas, the fact *that these rare foreign forms almost without exception indicate close*

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[1] Arktische Triasfaunen. Mém. de l'Acad. des Sciences de St. Pétersbourg. T. XXXIII, No. 6, p. 143.

[2] *Balatonites punjabiensis* from the Hydaspic stage of the Salt Range described by Waagen (Paleont. Indica, Ser. XIII, Salt Range Fossils, Vol. II, p. 64, pl. XXIV, Fig. 5) is based on a badly preserved specimen, and Waagen himself considers the determination of the genus doubtful. This specimen is in no way calculated to prove a fact of such great importance as the presence of *Balatonites* in the Indian Muschelkalk would be.

specific relationship with Mediterranean species throws a strong light upon their origin. It can therefore scarcely be doubted that the Trachycerata of the Carnic and the Juvavian stages of India are to be regarded as immigrants from the Mediterranean Province.

Among genera peculiar to the Indian Province but which in the Mediterranean Province only occur as great rarities or not at all, the following may be mentioned:—*Parajuvavites, Griesbachites, Guembelites, Tibetites, Thetidites* and *Bambanagites*. The Indian Province is, on the other hand, deficient in *Orthopleuritidæ* and *Celtitidæ*, as also in the genus *Margarites* and in the group of *Halorites catenati* which may all be assigned to the characteristic types of the Mediterranean Province. In the discussion of the age of each division of the beds attention has already been drawn to some groups characteristic of the Indian Province from genera which have also their habitat in the Mediterranean Province, *viz.*, the group of *Steinmannites undulatostriatus* and the group of *Halorites procyon*.

THE SEAS OF THE TRIASSIC PERIOD.

1. *The Thetys.* We have become acquainted with an uninterrupted period of the history of the Cephalopod faunæ of the Indian Province in the present memoir. That we can not, however, yet construct a complete and connected account of the succession of the Cephalopod faunæ of this province will be seen from the preceding observations. The older divisions of the Tyrolese series below the Julian fauna, and the younger divisions of the Bajuvarian series above the Lacic fauna are wanting. It must be left to later investigations to decide whether these divisions, wanting in the Indian Province, may yet be proved to exist by means of the Cephalopoda facies. On this point one cannot, with our knowledge of the Asiatic mountains still in its infancy, even venture on an opinion. But it was nevertheless very interesting to become acquainted with a larger division from the middle of the upper trias, and with the remarkable agreement with respect to the occurrence in succession of different genera and types, between the Mediterranean and the Indian Provinces.[1]

The Indian Trias Province forms an integral part of the Thetys, of which the Mediterranean Trias Province is to be regarded as the most westerly inlet. The best known areas of the Thetys are, according to the present state of our knowledge, as follow:—

1. The Mediterranean Province,
2. The Germanic shallow sea, and
3. The Indian Province.

The Germanic shallow sea forms a part of the Mediterranean Province and may be regarded as an estuary which was bordered by the extensive continent now sunk in the Atlantic Ocean. This triassic "Atlantis" existed probably already at the close of the Palæozoic period.[2] It reached, in the west, probably as far as the present North American continent,[1] which, as is known, possesses extensive triassic lacustrine deposits, of the character of the German Buntsandstein and Keuper in its eastern part; while pelagic deposits of the trias are only to be met with on the Pacific slopes of this continent. We shall return to this in referring to the great Arctic-Pacific Ocean of the Trias Period.

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[1] Cf. Cephalopoden der Hallstätter Kalke, II. Bd., p. 827.

[2] Suess, Antlitz der Erde. II. Bd., p. 317.

The relation which the Germanic estuary bears to the Mediterranean Trias Province has already been minutely discussed in former publications, to which we now simply refer in order to avoid repetition.[2] Only one important discovery recently made may be mentioned here, which gives a new clue to the relationship existing between the German Muschelkalk and the Mediterranean deposits. It is the discovery of *Ceratites nodosus* in Buchenstein limestone in the vicinity of Recoaro, by Dr. Al. Tornquist.[3]

The Buchenstein limestones form the lowest division of the Tyrolese series. Their equality in age with the Nodosus beds of the German Muschelkalk proves that the boundary so sharply defined in the Alps between the Dinaric and Tyrolese series lies midway in the Hauptmuschelkalk. While, namely, as Tornquist has shown, the Trochites limestones are paralleled with the zone of *Ceratites trinodosus* belonging to the Anisic stage, the Nodosus limestones belong already to the lower part of the Fassanic sub-stage.[4]

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[1] A good ground for the supposition that such a continent existed, is also given by the plant remains which have been found in the coalfields of Eastern Virginia, and identified by Stur with the plants of the Lunz sandstein (Julian Stage). Cf. Stur, the Lunz (Lettenkohlen) flora in the older Mesozoic beds of the coalfields of Eastern Virginia. Verh. Geol. R. A., 1888, p. 203.

[2] Dolomitriffe von Südtirol und Venetien, pp. 39-41, ferner E. v. Mojsisovics, W. Waagen und C. Diener, Entwurf einer Gliederung der pelagischen Sedimente des Trias Systems. Sitzungsber. der mathem. naturw. Cl. Bd. CIV, Abth. 1, p. 1273.

[3] Nachrichten der. K. Gesellschaft der Wissenschaften zu Göttingen, Mathem. naturw. Classe, 1896, 1. Heft pp. 5, *et seq.*

[4] Tornquist's discovery stimulates a discussion upon the upper boundary of the German Muschelkalk. It is known that the Lettenkohle is still referred to the upper Muschelkalk by distinguished German trias investigators. Benecke has only recently likewise agreed in his well known memoir upon the division of the upper Alpine Trias and upon Alpine Muschelkalk and Muschelkalk outside the region of the Alps (Ber. d. Naturforschenden Gesellschaft zu Freiburg i. B. Bd. IX, p. 221) with the opinion that the Lettenkohle must on account of its fauna be included in the Muschelkalk. From a palæontological point of view it seems scarcely possible to doubt this, for the Molluscan fauna, up to the Grenz Dolomite inclusive, is the same as in the Muschelkalk. From the Grenz dolomite of Thuringia two cephalopods have been known, *viz.*, *Ceratities Schmidi*, Zimmermann (Zeitshr. Deutsch. Geol. Ges. 1883, p. 382) and *Trematodiscus jugatonodosus*, Zimmermann (Jahrb. d. Konigl. preuss. geolog. Landesanstalt, 1889, p. 322) and it seems advisable to inquire whether the above question could not be answered by these discoveries.

With reference to *Ceratites Schmidi* it may be permissible to recall the observations which I published in the year 1883 on the occasion of the discovery of this Ammonite (N. Jahrb. f. Min. etc., 1884, I Bd., p. 78). I then said that, starting from the supposition of an almost parallel development and of the occurrence of representative forms in the Mediterranean region and in the Germanic basin, the Grenz dolomite should be placed parallel with the Buchenstein beds. But, at the same time, I emphasized the difficulties of such a distinct parallelism. Now when the proof is forthcoming that *Ceratites nodosus* occurs in the horizon of the Buchenstein beds, the justification of the opinion then expressed may be regarded as upheld, if the Lettenkohle be included in the upper Muschelkalk, or one could assume, taking into account the somewhat higher position of *C. Schmidi*, that the Grenz dolomite is of about the same age as the Marmolata limestone.

Trematodiscus jugatonodosus shows relationship with *Trematodiscus Klipsteini* from the St. Cassian beds, as Zimmermann has already recognised. But as Nautili are, on account of their rarity and slight variability, less suitable for exact determination of the horizons of neighbouring faunæ than Ammonites, the conclusion would be somewhat risky that the Grenz dolomite should be placed in the same horizon as the St. Cassian beds.

Out of the wide expanse between the Mediterranean and the Indian Provinces there are as yet only a few places known in which triassic fossils can be assigned to definite horizons. Two places may be mentioned in Asia Minor, one of which is to be assigned to the Juvavian stage, the other to the Dinaric series. The Juvavian specimens, which may perhaps represent the Sevatic sub-stage, come from Balia-Maaden in Mysia.[1] This fauna is too incompletely known for anything to be said about its local character. But the frequency of occurrence of the genus *Arcestes* might be noted as a Mediterranean feature of the fauna. The Dinaric fauna discovered by F. Toula in the Gulf of Ismid (Sea of Marmora) admits neither of a sharper marking off into horizons, nor does it show a distinct local character. A remarkable negative feature is the rarity of *Ptychites*. It is also worthy of note that in spite of the short distance from the still typically Mediterranean Dinaric deposits of Bosnia, so little relationship can be recognised to the Dinaric faunæ of the Mediterranean Province. Under these circumstances the more distinct definition of the horizon remains an open question.

Indications of the Scythian series have been obtained from the Araxes Pass near Djoulfa in Armenia, and it would be desirable if further investigations were undertaken in this place.[2]

Didymites afghanicus, described in this memoir, forms quite an isolated discovery. The specimen was collected by Griesbach in a loose block at the Mazarghan river (Zhob valley) and its locality has not yet been discovered.

As the genus *Didymites* is confined to the Alaunic fauna the supposition may be entertained that this horizon is represented in Baluchistan, but it has not as yet been recognised from any other region in Asia.

Of great interest also are the trias fossils of Eastern Pamir,[3] collected by F. Stoliczka and described by Ed. Suess, among which are three species of *Halorella* (among them being two species which agree with Mediterranean forms) and the true *Monotis salinaria*, so often incorrectly cited. *Halorella* as well as *Monotis salinaria* occur in the Mediterranean Province in the Alaunic and the Sevatic beds, so that it may be assumed that the specimens also found in Pamir may be referred either to the middle or the upper division of the Juvavian stage. It must be specially mentioned that neither *Halorella* nor *Monotis salinaria* has so far been known from the Himálaya. The type of *Monotis salindria* seems to be characteristic of the Thetys. It is found, according to Rothpletz, in Rotti in the Indian Archipe-

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I am therefore of opinion that further fortunate discoveries must be awaited before we are able to give a well-grounded judgment on the relationships of the Grenz dolomite to Alpine Horizons.

However this decision may result, it seems to me that something should be said about the parallelism between the Lunz sandstone and the Lettenkohle which has recently been brought again into the foreground, were it only for the purpose of expressing approval of Benecke's very appropriate remarks on this theme. Whether the Grenz dolomite is parallel with the Fassanic or, going to the utmost limits of possibility, with the Cordevolic formations, the Lunz sandstone should always be considered as belonging to the beds overlying, the equivalent of the Grenz dolomite. The correlation, always doubted by me, of the Lunz sandstone with the Lettenkohle, would therefore be negatived and all further conclusions from various sources, which have been come to on this subject, would fall through.

[1] E. v. Mojsisovics, Ueber der chronologischen Umfang des Dachsteinkalkes. Sitzungsber. d. mathem. naturw. Cl. Bd. CV., Abth. 1, p. 39.

[2] E. v. Mojsisovics, Verh. Geol. R.A., 1879, p. 171.

[3] Denkschriften, d. kais. Akad. d. Wiss. math.-naturw. Cl. Bd. LXI, pp. 458, *et seq.*

lago. The series of forms of *Pseudomonotis ochotica* replaces the type of *Monotis salinaria* in the region of the Arctic-Pacific Trias Province.

In the south of India the Thetys is bordered by extensive continental formations of the trias belonging to the old Gondwana land.[1] The trias of the Salt Range which has become known through W. Waagen's comprehensive investigations contains the most complete series of Scythian deposits. It is succeeded by the Hydaspic stage, already classed in the Dinaric stage as its lowest member, with which the triassic beds of the Salt Range, rich in fossils, terminate. From the yellow limestone lying at the base of the "variegated series" (Rhætic-Jurassic) Waagen only describes one form belonging to the Tropitidæ under the name of *Pseudharpoceras spiniger*[2] which reminds us somewhat of *Paratropites Phoebus* from the Tuvalic deposits of the Mediterranean Province. But this peculiar fossil does not suffice to base any well-founded supposition about the horizon to which it belongs. Taken as a whole the trias of the Salt Range appears in the middle and upper members as a development poor in fossils which, by reason of its geographical position between the Gondwana land in the south and the Pelagic triassic deposits of the high mountains in the north, seems to take a middle position analogous to that of the Germanic Trias between the continent of Atlantis and the trias of the Alps.

From the trias of Rotti only *Halobia* and *Daonella* have been known, besides *Monotis salinaria* already mentioned. Rothpletz who has described them[3] says that *Monotis* probably comes from a horizon different from that of *Halobia* and *Daonella*, as it has never been observed with them in the same pieces of rock. It must also be remarked that in the Hallstatt limestone the gregariously appearing *Monotis* always fills the rocks by itself and never occurs associated with *Halobia* and *Daonella*.

In favour of the view that *Monotis* from Rotti occurs in a horizon other than that of *Halobia* and *Daonella* it may however be mentioned that it comes from a locality in which it was found alone. *Monotis salinaria* is, as stated above, characteristic of the Alaunic and Sevatic faunæ. Much more difficult is the question as to the age of *Daonella* and *Halobia*, in which Rothpletz would recognise, besides *Daonella Lommeli* characteristic of the Longobardic horizon, still several other species, partly Carnic, partly Juvavian of the Mediterranean Province, but all of which, in Rotti, belong to one and the same horizon. In the great difficulty of distinguishing the species, often very similar to one another, of the two genera, I do not wish to attach too great a weight to the determination of the species. The association of *Halobia* and *Daonella*, as it occurs in Rotti,[4] is found in the

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[1] Suess, Antlitz der Erde, II. Bd., p. 318.

[2] Palæontologia Indica, Ser. XIII, Salt Range Fossils, Vol. II, P. 131, Pl. XXI, Fig. 1.

[3] Palæontographica, XXXIX, Bd., p. 89.

[4] The genera *Posidonomya*, *Daonella* and *Halobia* form a phyletic series. *Daonella* appears for the first time in the Anisic stage and *Halobia* in the Cordevolic period and reaches the highest point of its development in the Juvavian stage. The distinction of the typical forms is without difficulty. The genus *Daonella* forms the transition between *Posidonomya* and *Halobia*. If Rothpletz thinks that on account of the close relationship between *Daonella* and *Halobia* it is superfluous to distinguish *Daonella*, we cannot share this opinion. On the contrary we think that the distinction of the two genera is also desirable from a stratigraphical point of view.

Hallstatt limestone in Julian beds. But I should not from this circumstance alone like to draw the conclusion that *Halobia* and *Daonella* from Rotti must be Julian.

II. *The Region of the Arctic-Pacific Sea.* It is not improbable that the vast region, which in the year 1886[1] I comprised as the Arctic-Pacific Trias Province, may be divided into several smaller faunal districts. But this is not yet possible and the results of the detailed palæontological investigation, especially that of Californian trias, must be waited for, before we can move a step farther in this direction.

One of the most obscure points in the knowledge of the Pacific trias was the uncertainty about the position of the so widely spread beds with *Pseudomonotis ochotica.* The reason of this difficulty lay in the fact that the *Pseudomonotis* beds had up to this time been nowhere found in undoubted stratigraphical connection with other trias beds whose horizon was sufficiently well defined, and that in them no trias fossils had been known which could be referred to a definite horizon. It appears therefore of great importance to inquire whether the Californian *Monotis subcircularis* really belongs to *Pseudomonotis,* as Teller supposed, in which case it would fall into the series of forms of *Pseudomonotis ochotica.* Dr. Alpheus Hyatt had the kindness to communicate the reply to my request to the effect that he had undertaken a careful investigation into the subject, which places the reference of *M. subcircularis* to *Pseudomonotis* beyond all doubt. Upon this statement it seems now certain that the beds with *Pseudomonotis ochotica* actually belong, as was formerly assumed, to the upper division of the trias.

According to the data which Hyatt has published[2] on the trias of Taylorville in California and which will be discussed further on, *Pseudomonotis subcircularis* belongs to the Juvavian stage. *Pseudomonotis ochotica* is so closely related to *Pseudomonotis subcircularis* that Teller raised the question as to whether the two forms might not be identical. We shall therefore not make a great mistake if we assume that the beds with *Pseudomonotis ochotica,* which are now known from Siberia (Werchojansk on the Jana, and Mamga Bay in the Gulf of Okhotsk), Japan, New Caledonia, New Zealand and Australia (Nowra, New South Wales)—to indicate the distribution on the west coast of the Pacific Ocean—are likewise to be referred to the Juvavian stage.

It is not in contradiction of this assumption that Nautili of Juvavian habit had long ago been already cited[3] from New Zealand. It must also be remembered that I was lately in a position to determine from New Caledonia a *Phylloceras* of the group of *Ph. neojurense*[4] besides *Stenarcestes* described in the present memoir (cf. p. 96 above). It is true that there are no indications in this case about the locality and the relationship to the beds with *Pseudomonotis ochotica*; but it is nevertheless of interest to know that besides *Pseudomonotis* yet other fossils are now known which must also be referred to the Juvavian stage.

[1] Arktische Triasfaunen. Mém. de l'Acad. des sc. de St. Pétersbourg, VIIe série, t. XXXIII, No. 6.

[2] Bull. Geol. Soc. of America, Vol. III, p. 397.

[3] Cf Arktische Triasfaunen, p. 151.

[4] Comptes rendus des sciences de l'Academie des sciences. Paris, 18th Novembre, 1895.

In Japan five different occurrences of the trias are known,[1] *viz.*:—

1. The Ammonite-Slates of Inai (North Japan, Province of Rikusen).
2. The beds with *Pseudomonotis ochotica*, from the same region.
3. Pseudomonotis Limestones from the Sakawa basin (Shikoku, South Japan).
4. Daonella beds from the same region.
5. The impression of an ammonite, probably from the vicinity of Sakawa.

The Ammonite fauna of North Japan is distinguished by its close relationship to Californian forms, described by Meek and Gabb. It is of special interest for us as it affords the means of separating a number of forms from the species of the Star-Peak group of Nevada belonging as they are known to do to different horizons. These forms belong in all probability to the same horizon as the Japan fauna. I have referred this fauna in my work of 1888 to the Noric stage, and I still adhere to this determination. There are only a few genera represented, *viz.*:—*Ceratites, Arpadites, Danubites, Japonites Anolcites* and *Gymnites*, the greater number of which are also found in the Anisic stage. But there are also, on the other hand, types represented which have never been found before in the Anisic deposits, such as *Arpadites*, while *Anolcites*,[2] a member of the developmental series of Tirolitidae, could not be shown to be present either in the Anisic deposits of the Indian Province or in the deposits of the Arktis of the same age. *Anolcites* occurs in the Mediterranean Province for the first time in the Bosnian horizon and extends upwards into the Julian deposits. But *Anolcites* attains its chief development in the Noric stage of the Mediterranean Province. Only *Japonites* has been found among the rest of the genera in the Bosnian beds of the Indian Trias Province; it therefore forms the only type (not including those of Japan) which has only been found in the Anisic stage. But *Japonites* cannot on account of this circumstance be considered as a genus exclusively characteristic of the Anisic stage; for the information gathered respecting the vertical distribution of this rare genus is still much too meagre, and the simultaneous occurrence with *Arpadites* and *Anolcites* in the Japanese Ammonite limestones lends colour to the supposition that *Japonites* might also occur in higher horizons. The genus *Danubites*, to which the Ammonite described by me as *Ceratites Naumanni* belongs, has likewise not been proved to exist in Noric deposits, in the Mediterranean Province, while the genus *Buchites*, probably phyletically connected with *Danubites* is found in the Carnic as well as in the Juvavian deposits of the Mediterranean Province. It cannot therefore appear remarkable if *Danubites* has also been proved to exist in Noric deposits. The genera *Ceratites* and *Gymnites* extend, as is well known, up to the Julian period, but it must be mentioned that the later Ceratites are therefore reduced, dwarfed forms. On the other hand the Japanese Ceratites may, according to their dimensions and the stage of their development, be referred to the Ceratites of the Anisic and the Fassanic faunæ, to which latter (the Fassanic one) I should like to assign the small Japanese fauna in question.

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[1] E. v. Mojsisovics. Ueber einige japanische Triasfossilien. Beitr. zur Palæontologie, von Mojsisovics und Neumayr, Bd. VII, p. 163.

[2] To this genus I now refer the Californian species *An. americanus* (= *Whitneyi*, Gabb, pro parte, Palaeontology of California, Vol. I, Pl. IV, Fig. 12, not Fig. 11, which is to be regarded as *Arpadites Whitneyi*) and the closely related Japanese species *Anolcites Gottschei*.

The similarity in the character of the sculpture to the Juvavian species *Clionites Ares* is probably only to be looked upon as a phenomenon of convergent development.

As to the southern Japanese deposits of the trias, they seem to belong wholly to the Juvavian stage, for the beds with *Pseudomonotis ochotica*, which according to Naumann also occur in North Japan, are referable to this stage. The Daonella beds might also belong to the same period, as *Pseudomonotis ochotica* was also found therein. The impression finally of the Ammonite from Sakawa (*C. sakawanus*) which reminds us[1] in its habit of the Mediterranean genus *Cyrtopleurites* might be assigned to the genus *Tibetites*, representing this genus in India, or, to any closely related group. The Juvavian stage is therefore also in all probability indicated by this Ammonite.

Dinaric and Scythian deposits are only found beyond the Sea of Japan in the coast province of Eastern Siberia near Wladiwostok, in the southern Ussuri region and on the island of Russkij. The working out by Diener[2] of the interesting Cephalopod faunæ of this district made us acquainted with a fauna of the Brahmanic stage, tolerably rich in species, and with a still very meagre fauna of the Anisic stage. These discoveries occur at the most southerly point known up to the present time at which on the western side of the Pacific Ocean lower triassic deposits could be proved to exist.

On the eastern side of this large sea basin Scythian deposits have yet been determined only in Idaho, some distance from the coast and on the eastern slopes of the great Cordilleras as heteromesic intercalations at the base of the development of the red sandstone formation inland. In the great chain of mountains with pelagic development of the trias, bordering the Pacific Ocean, Scythian deposits are, so far as our present knowledge goes, wanting. Whether Dinaric deposits exist is still an open question. Upper triassic deposits are, on the other hand, distributed from Canada in the north to Peru in the south. Without wishing to attach too great an importance to the present statements which are certainly still very disconnected and imperfect, this restriction of the lower triassic formations to the Arctic regions, in which they can[3] be proved to exist with rich faunæ in the lower course of the Olenek and in some neighbouring islands of the Polar Sea as well as in Spitzbergen, deserves nevertheless to be noted. If this peculiar distribution should be confirmed by further investigation, one might surmise that the formation of the great Pacific basin took place only at the time of the upper trias. The greatest horizontal distribution is possessed by the Juvavian deposits with *Pseudomonotis ochotica* which show themselves in the coast regions of the great old Ocean, according to Teller, from Werchojansk in Siberia and from Alaska in the North to New Zealand and Peru in the South, connecting the Arktis with the Pacific basin.

Passing on to the discussion of the pelagic trias deposits in the Cordilleras of

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[1] Compare, for instance, *Cyrtopleurites Hutteri*.

[2] Mémoirs du comité géologique de St. Petersbourg, Vol. XIV, No. 3.

[3] E. v. Mojsisovics, Arktische Triasfaunen. Mém. de l'Acad, des Sciences de St. Pétersbourg, VII. Sèrie, t. XXXIII, No. 6; Ueber einige arktische Triasammoniten des nördlichen Sibirien, l. c., t. XXXVI, No. 5.

North America, it seems advisable to start from the data obtained from Alpheus Hyatt's and Perrin Smith's recent work in California. A favourable chance procured me the opportunity of discussing personally with Prof. Hyatt the distribution and interpretation of the triassic formations of California and Nevada, and among others I owe to Mr. Hyatt the valuable and interesting communication already mentioned, that a minute examination of *Monotis subcircularis* has shown him that this species really belongs to *Pseudomonotis* and may therefore be placed in the varietal series of *Pseudomonotis ochotica*.

In the neighbourhood of Taylorville Hyatt[1] observed on two hills having a parallel strike and evidently separated from one another by a fault the details of the divisions of the so-called Swearing slates and the Hosselkus limestone.

The stratigraphically older group of beds is evidently the Hosselkus limestone which lies here immediately upon deposits of carboniferous age. Its base is formed by the Halobia beds, slaty beds with a fossil-form similar to *Halobia superba*. The latter is a characteristic form of the Tuvalic limestones of the Salzkammergut. In an intercalated calcareous band of the slate a *Tropites* similar to *Tropites subbullatus*, with an *Arcestes* and an *Atractites*, was found. The typical Hosselkus limestone lying upon this slate contains, according to Hyatt's account, besides *Tropites* and *Atractites*, yet other species of the genera *Cladiscites*, *Arcestes* (of the groups of Galeati, Bicarinati and Sublabiati), *Badiotites* and *Juvavites*.[2] The frequency of *Arcestes* as pointed out by Hyatt is remarkable. The Hosselkus limestone was proved later still by Perrin Smith to be present on the mountain ridge between Squaw Creek and Pitt River with a great abundance of fossils, to which discoveries we shall refer later on. On the ridge which was investigated by Hyatt and which, on account of the occurrence of carboniferous deposits below the trias, obtained the designation of "Carboniferous Spur," the Hosselkus limestone forms the latest member at the summit of the hill.

The "Swearing Slates" which, as mentioned above, occur on a hill having a strike parallel to that of the Hosselkus limestone, reach likewise to the summit of the ridge. The beds underlying them are concealed by debris and therefore not observable. The lowest layer accessible forms the "Monotis bed," which is full of *Pseudomonotis subcircularis*. More rarely there appear in this layer:—

Pecten deformis, Gabb.
Hemientolium daytonensis, Gabb.
Modiola triquetraeformis, Hyatt.

The next layer is the Daonella bed, with the following fauna:—

Pseudomonotis subcircularis.
Daonella tenuistriata, Hyatt.
Hemientolium daytonensis, Hyatt.

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[1] Bull. Geol. Soc. of America. Vol. III, p. 397.

[2] As these determinations were made before the appearance of the second volume of the Hallstatt Cephalopoda, the supposition may be entertained that the form which Hyatt determined as a finely ribbed *Acrochordiceras* belongs to *Miltites* or *Juvavites*. The form compared with *Balatonites Waageni* may perhaps belong to *Thisbites* or *Eutomoceras*.

Modiola triquetraeformis, Hyatt.
Avicula mucronata, Gabb.
Inoceramus gervilloides, Hyatt.
Pecten inexpectans, Hyatt.
Lima acuta, Hyatt.

Besides the species which have become more rare of the "Monotis bed," the Daonella bed contains *Daonella tenuistriata* in addition to some other Pelecypoda.

Most of these bivalve shells, ***Pseudomonotis subcircularis*** included, extend also into the limestone overlying the Daonella beds which has been designated the "Rhabdoceras bed." Here appear also several Cephalopoda, *viz.*:—

Arcestes californiensis, Hyatt.
Halorites americanus, Hyatt.
Halorites Ramsaueri, Gabb (non Quenstedt).
Rhabdoceras Russelli, Hyatt.
Atractites, sp.

Arcestes also occurs frequently in this small fauna.

There can be no doubt that this complex of beds of the Swearing slates is of Juvavian age. Hyatt had correctly recognised the relationship to the homotaxial deposits of the Mediterranean Province, and had, in agreement with my former view of the case, placed these beds in the Noric in a lower horizon than the Carnic Hosselkus limestone. But as this latter, as already mentioned, overlies carboniferous beds, there can be no doubt that it forms the lower member of the triassic deposits of Taylorville. The occurrence of *Halorites* and *Rhabdoceras* is conclusive proof of the Juvavian age of the Swearing slates. The presence of a catenate *Halorites* (*H. Ramsaueri*, Gabb) is of interest. The division of catenate *Halorites*, a fact already emphasized, is wanting in the lower Juvavian deposits of the Himálaya, while acatenate *Halorites* are frequent. As the connection between the Mediterranean Province and the Pacific basin can only have been made by means of the Thetys, the thought occurs to one that the emigration of the catenate *Halorites* to the Pacific basin may have taken place only in the middle or upper Juvavian period. The genus *Rhabdoceras* is also wanting in the Lacic deposits of the Indian Province, whilst it occurs in the Mediterranean Province, like the catenate *Halorites*, already in the Lacic deposits. ***Pseudomonotis subcircularis*** belonging to the varietal series of *P. ochotica* is unquestionably to be reckoned among the most characteristic fossils of these Swearing slates, and from the above remarks on the age of the Swearing slates it results that these mollusca, so characteristic of the Arctic-Pacific trias basin, belong to the middle or upper Juvavian stage. It is a strange coincidence that ***Monotis salinaria*** of the Mediterranean trias, in outline and sculpture so strikingly similar to ***Pseudomonotis subcircularis***, has likewise its habitat only in the Alaunic and Sevatic deposits of the Juvavian stage. The question of a phyletic connection of both forms naturally suggests itself, but we will content ourselves with this surmise and leave the question of the possibility of the derivation of ***Monotis*** from ***Pseudomonotis*** to a future time.

The papers[1] published by Perrin Smith on Shasta county form in many respects a valuable supplement to Hyatt's sections of Taylorville (Plumas county). Shasta county is wanting in the complex of beds with Juvavian fauna designated by Hyatt as "Swearing slates." The highest member of the trias of Shasta county is formed by the Hosselkus limestone, which again has several subdivisions. The two lower subdivisions are rich in Cephalopoda. A faunally important distinction between the lowest division—the Trachyceras beds, and the succeeding series—the Atractites beds, does not seem to exist. The uppermost group—the Spiriferina beds—contains only a few remnants, not yet determined, of Brachiopoda and Pelecypoda. According to the preliminary lists of Cephalopoda published by Perrin Smith the fauna may be compared with the Tuvalic fauna of the Mediterranean Province. I can but confirm this view of its relationship on the evidence of some Cephalopoda (especially *Tropites* and *Paratropites*) kindly sent me by Professor Perrin Smith. All the types characteristic of the Tuvalic fauna are here repeated in the same association in a surprising manner. The Californian species are extremely closely related to the Mediterranean species of this horizon; some may prove upon a closer examination even identical with them. I will not enter more minutely into a discussion of the lists of fossils, as a thorough palæontological investigation of these faunæ by Messrs. Hyatt and Perrin Smith is shortly expected; I must, however, allude to the striking fact that in California, especially in the lower division of the Hosselkus limestone (the so-called Trachyceras beds) a greater number of Trachycerata occurs with the otherwise typically Tuvalic fauna. One might therefore suppose that here there was a transition fauna, composed of Julian and Tuvalic elements, somewhat similar to the fauna of the beds with *Lobites ellipticus* in the region of Aussee. But this latter is decidedly to be considered a Julian fauna, in which a few Tuvalic species and types occur for the first time. The Californian fauna must, however, from the nature of its composition be regarded as a Tuvalic one, in which, in contrast to the Mediterranean Province and in agreement with the Indian Province, the genus *Trachyceras* still survives. In the Mediterranean Province *Trachyceras* appears for the first time in the Julian fauna, while the genus ascends in India as well as in California still into the Tuvalic fauna.

The Hosselkus limestone forms in Shasta county the upper member of the so-called "Cedar Formation," while the complex of slates termed Swearing slates by Perrin Smith represents the lower member. These slates are however distinguished by its fauna as well as by its stratigraphical position from the Swearing slates of Taylorville which, according to Professor Hyatt's oral communication, are to be regarded as the type. These latter belong, as already mentioned, to the Juvavian stage, while the slates of the "Cedar Formation" should be assigned to a lower horizon.

The upper division of these slates which precedes immediately the Hosselkus limestone seems to me to correspond completely to the Halobia bed occurring in the same position near Taylorville, for it also contains *Halobia superba* and some Carnic Cephalopoda types, such as *Polycyclus*, *Eutomoceras* and *Trachyceras*.

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[1] The Metamorphic Series of Shasta County, California. Journal of Geology, Vol. II, No. 6, pp. 602-909. Mesozoic changes in the faunal Geography of California. Journal of Geology, Vol. III, No. 4, pp. 374-377.

The lower division of the same slates is formed by the "Trachyceras Homfrayi beds" which contain numerous remnants of this species, recalling in the character of the sculpture *Anasirenites tripunctatus* from the Julian limestones of the Salzkammergut. I am not in a position, being guided only by Gabb's illustration in the Palæontology of California, to decide whether there is here actually an *Anasirenites* present. The confirmation of its existence would be of chronological interest, for the oldest representatives of the genus *Anasirenites* occurs in the Mediterranean Province only in the Julian beds. Besides these Ammonites there occur, according to Perrin Smith, in the Homfrayi beds, *Halobia superba* and *Halobia rugosa* as well as rare specimens of *Pseudomonotis* related to *P. subcircularis.* It would be of interest to verify this determination anew, as, according to Hyatt's careful account, the Juvavian Swearing slates form the true horizon of *Pseudomonotis subcircularis.*

The "Cedar Formation" (to which belong the groups of beds just mentioned and assigned to the Carnic stage) is, according to Perrin Smith, underlaid in Shasta county by the Pitt Formation, an Isopic system, about 3000 feet thick, of highly siliceous and calcareous slates, conglomerates and tuffs, the upper thicker half of which belongs to the trias, while the lower part contains carboniferous fossils. The triassic portion of these beds is unfortunately very poor in fossils. There are a few Ammonites, Brachiopoda and bivalve shells, mostly very badly preserved, about 1,500 feet below the Homfrayi beds. Perrin Smith makes mention, among the Ammonites, of *Trachyceras Whitneyi*, Gabb, a species which has also been found in the Star-Peak Group of Nevada. The determination of this species, to which Gabb has evidently given too wide a scope, offers some difficulty which without obtaining the specimens in question cannot be solved solely from Gabb and Meek's descriptions and illustrations. Gabb figured as *Ammonites Whitneyi* two specimens which have nothing in common but the interruption of the sculpture on the external part. Having regard to their external appearance these two specimens might belong to two different genera, *viz.*, *Arpadites* (*Clionites*) and *Trachyceras* (*Anolcites*). It is however not impossible that the two species may belong to one and the same genus (*Anolcites*), but only a renewed examination of the original specimens and particularly the observation of the inner whorls could lead to a satisfactory conclusion. The type which I have designated *Trachyceras americanum*[1] would be placed in the subgenus *Anolcites*, to judge by Meek's illustration.

I consider the division of the trias of North America which contains these two species to be Noric and come now to the consideration of the Cephalopoda from the trias of California and Nevada described by Gabb[2] and Meek.[3]

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[1] The name of the species *Whitneyi* must be retained for Fig. 11, Pl. IV of Gabb, Palæontology of California, while I have proposed the designation *Trach. americanum* for Fig. 12 of the same plate. Arktische Triasfaunen, p. 149.

[2] Palæontology of California, Vol. I.

[3] U. S. Geological Exploration of the fortieth Parallel by Clarence King, Vol. IV., Part 1 by F. B. Meek.

As according to the valuable observations of Hyatt and Perrin Smith there can now be no doubt as to the fact that in the pelagic trias of North America a series of horizons exists varying in age, the Star-Peak Group of Nevada can also no more be regarded as a uniform complex. It may rather be assumed with tolerable certainty that the Star-Peak Group comprises the whole of the Tyrolese series, and Professor Hyatt personally informed me that the fossils described in the publications of Gabb and Meek are not the result of systematic investigation of certain beds, but of specimens casually gathered together from a mountain range which has been subjected to much crumpling and dislocation.[1]

As presumably Carnic species of the Star-Peak Group the following might be mentioned:—

Anmonites Homfrai, Gabb.
Mojsvarites (*Monophyllites*) *Billingsianus*, Gabb.[2]
Eutomoceras Laubei, Meek.

As forms, not yet placed in definite horizons, might be named:—

Sageceras Gabbi, Mojs. (Ceph. der Hallst. K., 1. Bd., p. 71).
Arcestes (*Proarcestes*?) *Gabbi*, Meek.
(?) *Joannites* ind. (=*Ammonites Ausseeanus*, Gabb).[3]
Eudiscoceras Gabbi, Meek.

After withdrawing these species there remain the following:—

Arpadites (*Clionites*?) *Whitneyi*, Gabb, sp.
Anolcites americanus, Mojs.
Ceratites Blakei, Gabb.
„ *Meeki*, Mojs.
„ *nevadanus*, Mojs.
Acrochordiceras Hyatti, Meek.
Danubites Halli, Mojs. (=*Clydonites laevidorsatus*, Meek).
Anolcites Alphei, Mojs. (=*Trach. judicaricum*, Meek).
Protrachyceras subasperum (=*Trach. judicaricum* var. *subasperum*, Meek).

Of these forms only *Acrochordiceras Hyatti*, in accordance with the experience gained from the study of fossils of other localities, points to a lower horizon, namely, the Dinaric series, and it might be possible that in the Star-Peak Range Dinaric deposits also exist from which the above-named *Acrochordiceras* originates.

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[1] That Hyatt (Bull. Geol. Soc. of America, Vol. III., p. 400) as well as Perrin Smith should assert that I had placed the Star-Peak Group in the Muschelkalk rests upon a misunderstanding which is inexplicable to me. Hyatt unfortunately does not quote any authority in support of this statement. Perrin Smith cites (Journal of Geology, Vol. II, No. 6, p. 603) my diagnosis of the genus *Acrochordiceras*, in which it is pointed out that this genus has only been found up to the present time in the Mediterranean Province in the Muschelkalk. There is here not a syllable said about the American trias. I have always maintained the opinion that the fauna described by Gabb and Meek is upper triassic (Noric) (Ueber Daonella and Halobia. Abh. Geol. R.A., Bd. VII., Heft 2, p. 23.—Arktische Triasfauren p. 149). To avoid the possibility of further erroneous interpretation I recall the fact that till the year 1892 when I rejected the "Juvavian Trias province," accepted up to that time, I designated as Juvavian types all those forms which are peculiar to the Hallstatt limestones, but are wanting in the rest of the Alpine triassic deposits, as for instance, the great number of upper triassic Tropitidæ and Haloritidæ.

[2] American Journal of Conchology, Vol. V.

[3] According to the suture-line given by Gabb this form cannot be an *Arcestes*. I consider the sutures to be much injured, either artificially or by weathering.

But it might also be supposed that *Acrochordiceras* ascends in the Pacific region into the lowest member of the Tyrolese series, for the vertical distribution of each genus in the different provinces is not necessarily the same in all cases. In illustration of this we refer to the genus *Trachyceras*, which in the Indian and the Pacific Provinces ascends to the Tuvalic fauna but is wanting in the Mediterranean Province.

Leaving this an open question we pass on to the discussion of the remaining fauna to which relationship the analogies with the lower Noric (Fassanic) Cephalopod fauna of North Japan point, as the following tabulation shows :—

NEVADA.	NORTH JAPAN.
Ceratites Blakei.	*Ceratites Japonicus.*
Ceratites Meeki.	*Ceratites Haradai.*
Ceratites nevadanus.	*Arpadites* (*Clionites*) sp.
Arpadites (*Clionites*) *Whitneyi.*	*Anolcites Gottschei.*
Anolcites americanus.	*Danubites Naumanni.*
Danubites Halli.	

The association of true *Ceratites* of normal dimensions with *Arpadites* and *Anolcites* as it is exhibited to us in the two small faunæ of Nevada and North Japan is characteristic of the Fassanic sub-stage of the Mediterranean Province, and to this I should like to assign that division of the Star-Peak Group which comprises the fauna tabulated above. If Meek's illustration be correct, *Anolcites Alphei* represents quite a peculiar type of which the symmetrical bundle-like arrangement of the ribs is characteristic. *Protrachyceras subasperum* is likewise a new type which is foreign to the Mediterranean Province.

The fossils collected in the triassic areas of British Columbia and described by Whiteaves in the "Contributions to Canadian Palæontology,"[1] and whose state of preservation often leaves much to be desired, evidently belong to different horizons. Having regard to the palæontological relationship of the forms represented it appears probable that the same stages exist in British Columbia as in Nevada and California; but judging from Whiteaves' illutrations one can conclude, with some probability, that the Carnic and the Juvavian stages are present. The existence of the Anisic stage here is also not yet proved with certainty, for the Ammonites described by Whiteaves as *Popanoceras Mc.Conelli* belong, as the drawing of the sutures shows, neither to the Anisic genus *Parapopanoceras*,[2] nor to the permian genus *Popanoceras*, but represent a new type of the Arcestidæ with prionidic sutures about whose stratigraphical position no certain conclusions can yet be drawn. *Trachyceras canadense* seems, according to Hyatt and Whiteaves, to be a true *Trachyceras* with divided external tubercles, and it would therefore point to the Carnic age, as *Trachyceras* is characteristic of the Carnic stage. The same conclusion is arrived at with respect to *Aulacoceras carlottense*, as the genus *Aulacoceras* has as yet been known only in the Carnic stage.

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[1] Vol. I., pp. 127-149., Pl. 17-19.

[2] Cf. p. 115 above.

The fragment of a volution figured as *Acrochordiceras* (?) *carlottense* might belong to a *Juvavites*.

The forms figured as *Arniotites*[1] and *Badiotites* cannot be employed for the determination of the horizon of the beds to which they belong, partly on account of their novelty and partly on account of their bad state of preservation. The presence, on the other hand, of *Pseudomonotis, subcircularis* shows that the Juvavian stage is here represented.

No newer data are available respecting the triassic deposits of South America (Columbia, Peru). They belong to the Juvavian stage and were remarked upon by me in the year 1886.[2]

The preceding observations only give a rough and incomplete sketch of the upper triassic deposits of the Arctic-Pacific Trias Province: the framework so to speak of their divisions and their chronological significance. Many local peculiarities may, nevertheless, be recognized which have already been pointed out in the course of this memoir. More precise conclusions would seem to me to be premature. They could only be arrived at after the palæontological working out of richer and fuller material.

If we glance at the whole vast region of the pelagic trias of the Thetys and the Arctic-Pacific Ocean, the restriction already emphasized in 1886 of the Tirolitidæ to the Mediterranean Province at the Scythian and the Dinaric periods, strikes us above all as one of the most important biological features. Only in the Noric period the Tirolitidæ, then endemic, spread from the Mediterranean Province over the great seas and penetrated as far as the eastern shores of the Pacific basin.

There can hardly be a doubt that the poor Cephalopod fauna of the Werfen beds extended from the eastern regions of the Thetys into the small

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[1] I distinguished at a time (1882) when one was much more sparing and cautious in the creation of new genera, three groups in the genus *Balatonites* established by myself (Ceph. der mediterranen Triasprovin, p. 77), *viz.*, the group of *B. gemmati*, the group of *B. arietiformes* and the group of *B. acuti*. Hyatt in 1889 (Contributions to Canadian Palæontology, Vol. I., by J. S. Whiteaves, p. 144) proposed to raise these three groups to the rank of genera, of which the group of *B. gemmati* should retain the name *Balatonites*, the group of *B. arietiformes*, however, should get the name of *Arniotites* and the group of *B. acuti* that of *Dorikranites*. But unfortunately Hyatt (l. c. p. 146) regarded as the type of the genus *Arniotites* a form from Vancouver Island which certainly cannot be assigned to my group of B. *aristiformes*. It is difficult to get a correct impression of the character and systematic position of this form from the very poor figure and insufficient description of *Arniotites Vancouverensis*. The figure as well as the description indicate that the inner whorls are completely smooth, and that the straight simple ribs, without tubercles, occur only in the anterior half of the penultimate whorl. The sutures and the length of the body-chamber are unknown. I am not able with the existing data to express any opinion upon the possible relationship of *Arniotites* to a European or Asiatic type. But for the group of *B. arietiformes*, as *Arniotites* has certainly nothing to do with it, a new generic name should be employed and I propose that of *Judicarites*. *Judicarites* has ceratitic sutures and whorls embracing to the extent of about one half. A median keel with faint tubercles is raised upon the truncated external part. The strong ribs, mostly undivided, occur on the outer whorls at wide intervals. They run straight across the sides and bend on the external part with knot-like swellings, knee-shaped towards the anterior.

[2] Arktische Triasfaunen, p. 151.

Mediterranean area. The migratory forms consisted, putting aside the isolated Meekocerata, only of Dinaritidæ from which then, perhaps under the influence of a temporary isolation, the Tirolitidæ branched off.

A later importation of foreign elements into the Mediterranean region occurred then in the Dinaric period. It extended also into the neighbouring Germanic basin, in which, however, probably likewise under the influence of a considerable isolation, a further special and independent development took place, while the Mediterranean gulf remained in open connection with the Thetys. The Indian regions of the Thetys[1] were in uninterrupted communication with the Arctic regions in the Scythian as well as in the Dinaric periods.

At the beginning of the Tyrolese epoch Tirolitidæ began their migration from the Mediterranean gulf through the Thetys into the great Pacific basin, which from this period, as it seems, increased in extent and pushed its shores farther and farther towards the south. The distribution of the Tirolitidæ over the vast areas of the Thetys and the Pacific region is a phenomenon of great biological importance and it seems therefore advisable to preserve the boundary between the Dinaric and Tyrolese series below the Fassanic fauna.

The Mediterranean gulf attained the greatest enrichment of its Cephalopod population at the time of the Julian fauna. Though the Indian fauna of this period is only imperfectly known, the most important of these genera, occurring independently, are likewise found in it. The knowledge of the fauna of this period is still more incomplete. But in the rich fauna of the Tuvalic period, immediately succeeding, we also meet with the same genera and types on the eastern coast of the Pacific basin as we do in India and in the Mediterranean Province. On a former occasion I have already referred to the apparently simultaneous occurrence of types in remote regions of the sea and I have dwelt upon the surprising fact that in the Mediterranean as well as in the Indian trias a concordant order of succession of each fauna can be proved.[2] It is now shown that this phenomenon also extends to the Pacific region and that it therefore comprises the whole vast region of the pelagic triassic deposits which are yet known to us. I confess that this result is rather unexpected. The farther we extend the borders of our knowledge the more difficult and enigmatical will the question become as to the habitat of the cryptogene types which play so important a part in the history of the pelagic animal world. It is true that vast regions of the surface of the earth are still closed to us, and at the time of the upper trias remarkable changes in the distribution of the continents and in the extent of the seas, especially in the region of the Pacific Ocean (cf. p. 143 above) must have taken place. We can therefore still hold to the opinion that the cryptogene types originated from marine areas which are yet unknown to us. And in a similar way it must, in judging of this class of phenomena, be borne in mind that changes in the physical character of the surface of the earth must have most materially influenced the distribution of the organic beings thereon.

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[1] The probable objection, that Noric faunæ are yet unknown in the Indian Province, can be met by pointing out the small circumference of the more closely examined area. The want of sediments in the sections so far studied seems to be the cause of the absence of Noric stage. In any case the connection between the Mediterranean Province and the Pacific Ocean is only conceivable by means of the Thetys.

[2] Cephalopoden der Hallstätter Kalke, II. Bd., p. 827.

Series.	Stages.	Sub-stages.	Zones of the Mediterranean Province.	Germanic Basin.	Asia Minor.
BAJUVARIAN.	Rhætic	Rhætic	22. Zone of *Avicula contorta*	Bone-bed.	
	Juvavian.	Sevatic	21. Zone of *Sirenites Argonautæ*		Fauna of Balia Maaden.
			20. Zone of *Pinacoceras Metternichi*		
		Alaunic	19. Zone of *Cyrtopleurites bicrenatus.*		
		Lacic	18. Zone of *Cladiscites ruber*		
			17. Zone of *Sagenites Giebeli*		
TYROLESE.	Carnic.	Tuvalic	16. Zone of *Tropites subbullatus*		
		Julian.	15. Zone of *Trachyceras Aonoides*		
		Cordevolic	14. Zone of *Trachyceras Aon*		
	Noric.	Longobardic.	13. Zone of *Protrachyceras Archelaus.*		
		Fassanic.	12. Zone of *Dinarites avisianus*	*Ceratites Schmidi* ?	
			11. Zone of *Protrachyceras Curionii.*	Zone of *Ceratites nodosus.*	
DINARIC.	Anisic	Bosnian	10. Zone of *Ceratites trinodosus*	Trochites Limestone	Fauna of the Gulf of Ismid ?
		Balatonic	9. Zone of *Ceratites binodosus*	Zone of *Ceratites antecedens.*	
	Hydaspic	Hydaspic		*Hungarites Strombecki.*	
SCYTHIAN.	Jakutic.		Zone of *Tirolites cassianus*	*Beneckeia tenuis.*	
		Jakutic.		Buntsandstein.	
	Brahmanic	Gandaric			
		Gangetic			

of the Thetys.

Armenia.	Baluchistán.	Pamir.	INDIAN PROVINCE.		East Indian Archipelago.
			Himálaya.	Salt Range.	
			↑Hochgebirgskalk ?	Variegated Series.	
		Rocks with *Monotis salinaria* and *Halorella.*	" Sagenites beds " ?		*Monotis salinaria* of Rotti.
	Didymites.		Beds with *Spiriferina Griesbachi*		
			Zone of *Steinmannites undulato-striatus.*		
			Zone of *Clydonautilus Griesbachi*		
			Tropites Limestone of Kalapani		
			a. Daonella beds b. Beds of *Trach. tibeticum.*	*Pseudharpoceras spiniger* ?	*Halobia* and *Daonella* of Rotti.
			Zone of *Ptychites rugifer.*		
			Zone of *Sibirites Prahlada.*		
				8. Zone of *Stephanites superbus.*	
Clarai beds of the Araxes Pass.			Beds with *Ceratites subrobustus.*	7. Zone of *Flemingites Flemingianus.*	
				6. Zone of *Flemingites radiatus.*	
				5. Zone of *Ceratites normalis.*	
				4. Zone of *Proptychites trilobatus.*	
				3. Zone of *Proptychites Lawrencianus*	
				2. Zone of *Gyronites frequens.*	
			1. Zone of *Otoceras Woodwardi.*		

Series.	Stages.	Sub-stages.	Australia and New Zealand.	New Caledonia.	Japan.	Ussuri Region.	Werchojansk and the Gulf of Okhotsk.
	Rhætic	Rhætic					
BAJUVARIAN.	Juvavian.	Sevatic	Beds with *Pseudomonotis ochotica.*	Beds with *Pseudomonotis ochotica and Stenarcestes.*	Beds with *Pseudomonotis ochotica.*		Beds with *Pseudomonotis ochotica.*
		Alaunic.					
		Lacic.					
TYROLESE.	Carnic.	Tuvalic.					
		Julian.					
		Cordevolic.					
	Noric.	Longobardic.					
		Fassanic			Beds with *Ceratites japonicus.*		
DINARIC.	Anisic.	Bosnian				Beds with *Monophyllites sichoticus.*	
		Balatonic.					
	Hydaspic.	Hydaspic.					
SCYTHIAN.	Jakutic.	Jakutic.					
	Brahmanic.	Gandaric				Beds with *Proptychites hiemalis.*	
		Gangetic.					

the Arctic-Pacific Ocean.

New Siberian Islands, mouth of the Olenek.	Spitzbergen.	Idaho.	Alaska and British Columbia.	Nevada and California.	Columbia, Peru.
			Beds with *Pseudomonotis subcircularis.*	Swearing slates with *Rhabdoceras Russelli* and *Pseudomonotis subcircularis.*	Beds with *Pseudomonotis ochotica.*
			Probably agreeing with Nevada and California.		
				Hosselkus limestone with *Tropites.*	
				Homfrayi beds.	
				↑ Star-Peak Group. ↓	
				Beds with *Anoleites americanus.*	
Beds with *Hungarites triformis*	*Daonella* limestone.				
	Posidonomya limestone.				
Olenek beds with *Ceratites subrobustus.*		*Meekoceras* beds.			

PLATE I.

HALORITES.

HALORITES PROCYON, E. v. Mojs., p. 9. (Cf. Pl. II., Pl. III., Figs. 1, 2.)

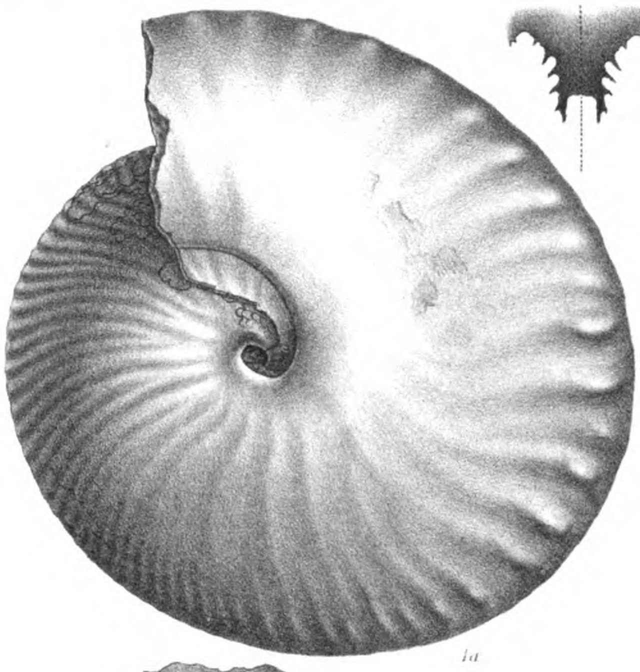
Fig. 1. VAR. OBLIQUA. Nearly complete specimen with the body-chamber, most of it a cast. From the Halorites Limestone of the Bambanag Section.

„ 2. VAR. OBLIQUA. Incomplete specimen, for the most part without the test, with half a whorl of the body-chamber. From the same locality.

„ 3. VAR. OBLIQUA. Chambered cast with only a little of the test remaining. From the same locality.

„ 4. VAR. RECTA. Specimen with the body-chamber and the apertural margin, most of it a cast. From the same locality.

All the figures are of the natural size, and were drawn on the stone without the use of a reflector.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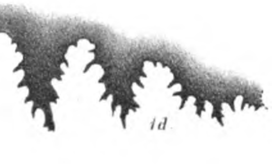
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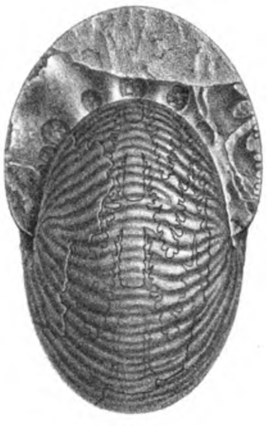
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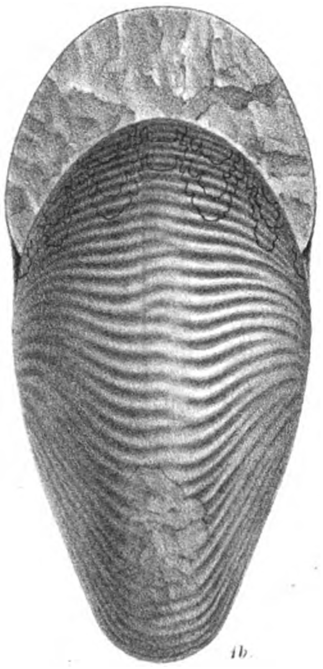
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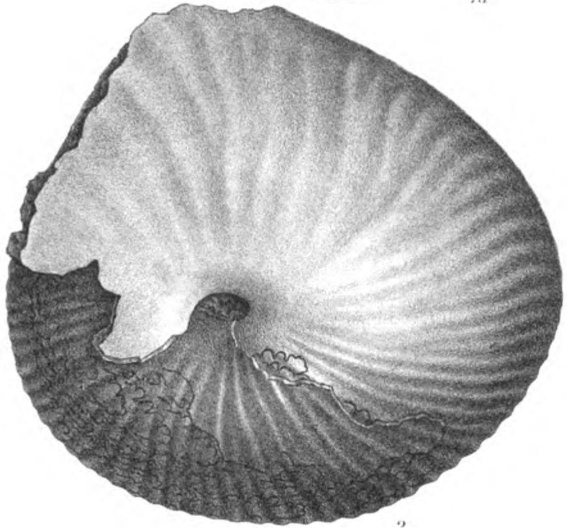
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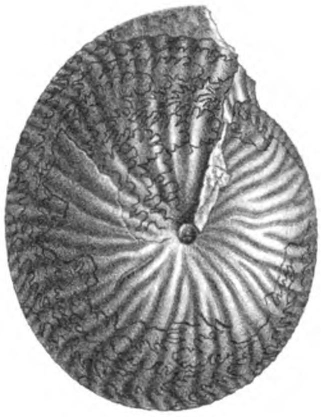
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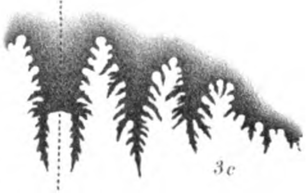
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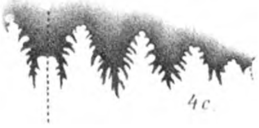
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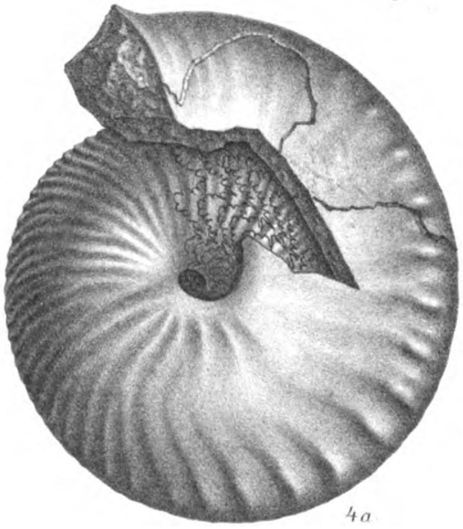
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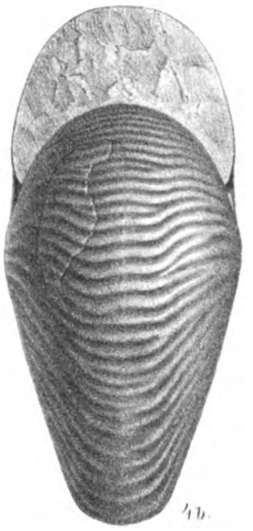
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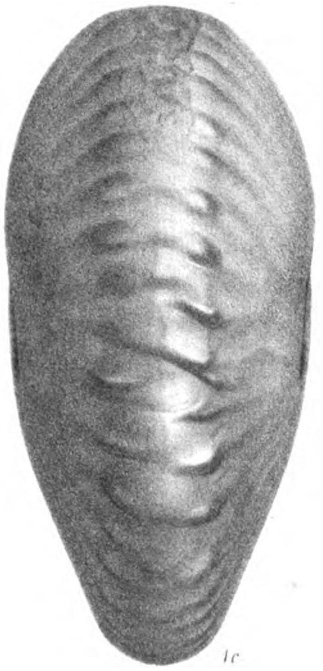
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R. Mayer del. et lith.
Th. Bannwarth print.

PLATE II

HALORITES.

HALORITES PROCYON, E. v. Mojs., p. 9. (Cf. Pl. I and Pl. III, Figs. 1, 2.)

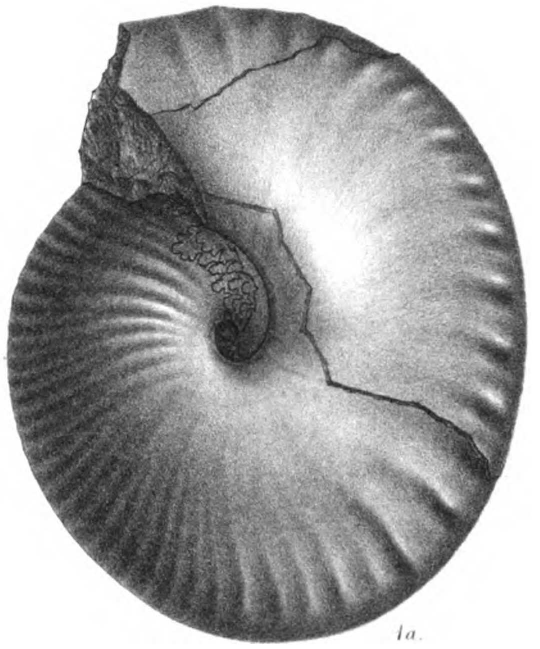
Fig. 1. VAR. OBLIQUA. Nearly complete specimen with the body-chamber; most of it a cast. From the Halorites Limestone of the Bambanag Section.

„ 2. VAR. RECTA. Cast of a nearly complete specimen with the body-chamber. From the same locality.

The figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

UPPER TRIAS, HIMÁLAYA. VOL: III.

Geological Survey of India. Pl. II.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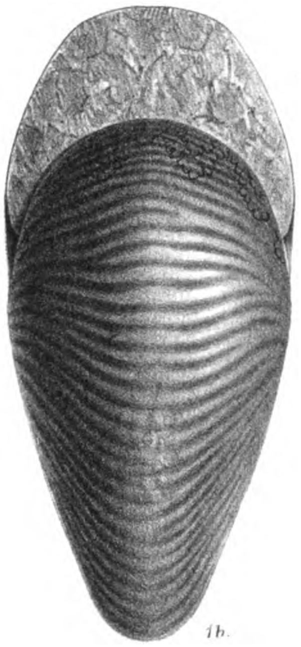
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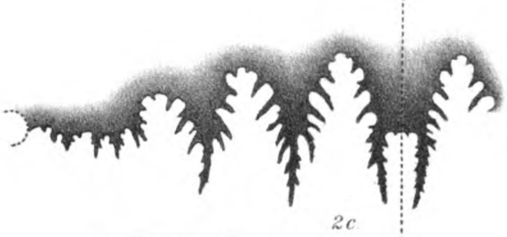
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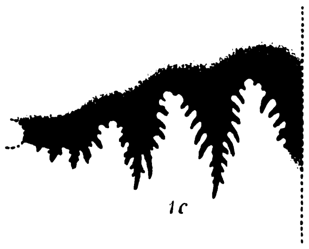
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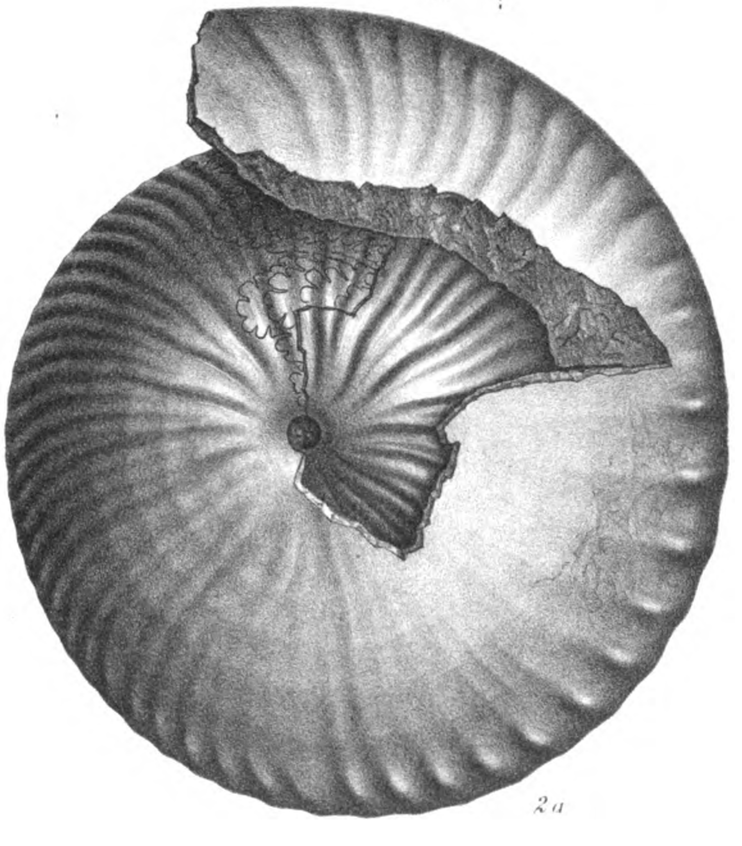
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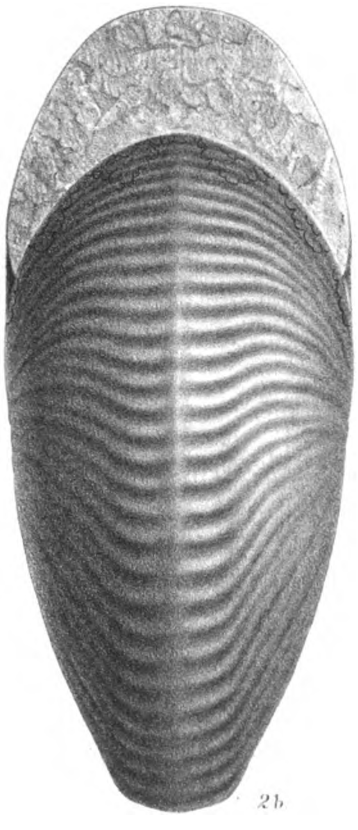
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R. Mayer del. et lith.

Th. Bannwarth print.

PLATE III.

HALORITES.

HALORITES PROCYON, E. v. Mojs., p. 9. (Cf. Pl. I, Pl. II.)

Fig. 1. VAR. RECTA. Internal cast with the test, with fragment of cast of the last whorl of the body-chamber. From the Halorites Limestone of the Bambanag Section.

„ 2. VAR. RECTA. Cast of a fragment with the body-chamber. From the same locality.

„ 3. HALORITES ALCACI, E. v. Mojs., p. 17. Specimen with the body-chamber and part of the test; provided with the aperture. From the same locality. In the figures 3c and 3d part of the last whorl was removed in order to represent the external part of the penultimate whorl.

„ 4. HALORITES CHARAXI, E. v. Mojs., p. 15. Nearly complete specimen with the body-chamber, most of it without any test. From the same locality.

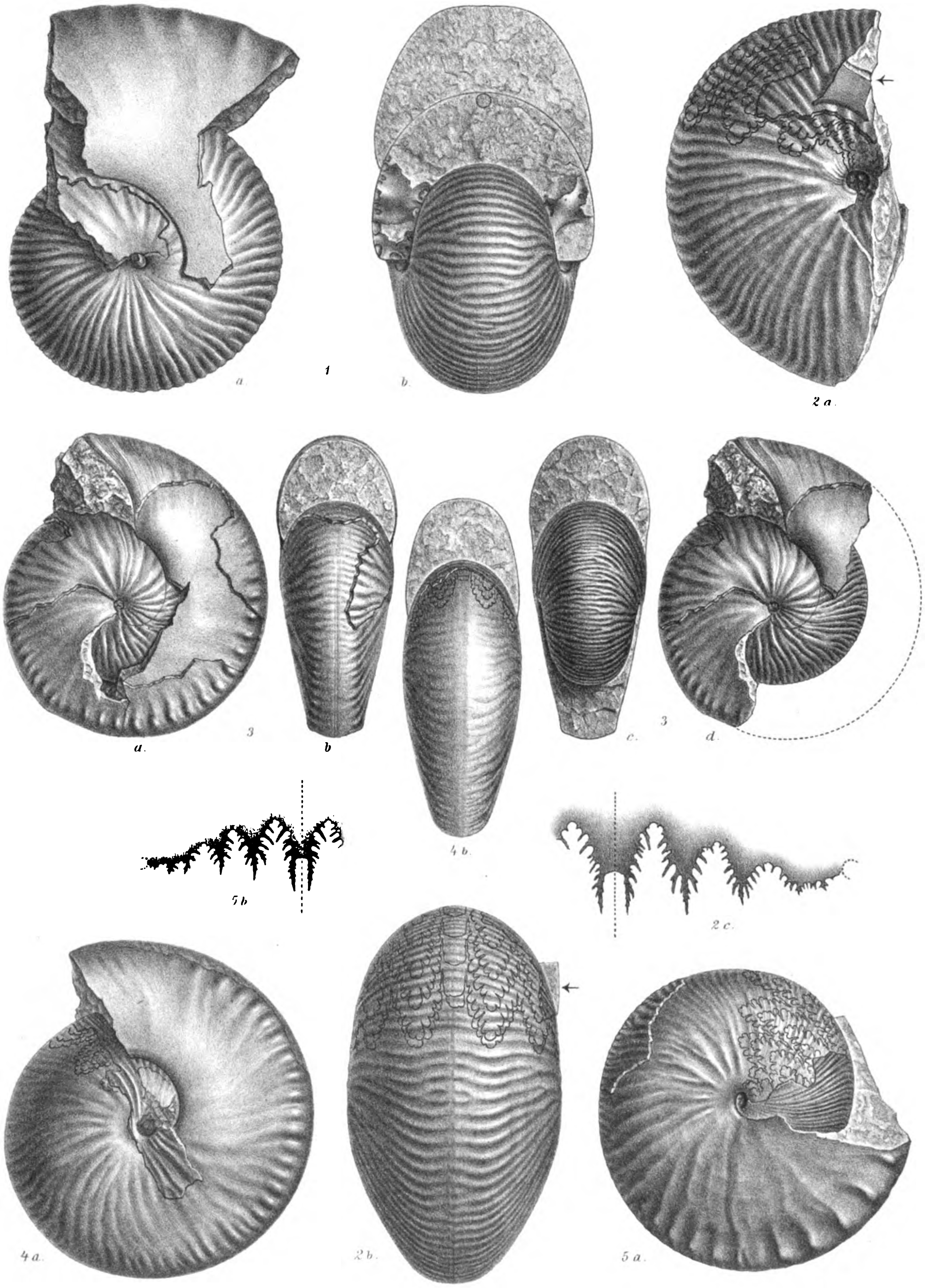
„ 5. HALORITES PHAONIS, E. v. Mojs., p. 16. (Cf. Pl. V, Fig. 1.) VARIETAS. Incomplete specimen, most of it without the test, with part of the body-chamber whorl. From the same locality.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

UPPER TRIAS, HIMÁLAYA. VOL: III.

Geological Survey of India.

Pl. III.



R. Mayer del. et lith.

Th. Bannwarth print.

PLATE IV.

HALORITES.

HALORITES SAPPHONIS, E. v. Mojs., p. 13.

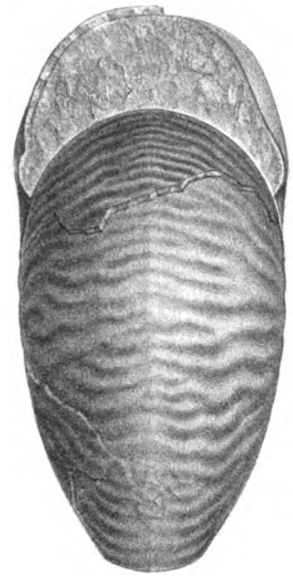
Fig. 1. Specimen with the body-chamber and part of the test. From the Halorites Limestone of the Bambanag Section.

„ 2. Chambered cast with the beginning of the modified body-chamber whorl. From the same locality.

„ 3. Specimen with part of the test and provided with half of the body-chamber whorl, placed in the position of a complete example of the body-chamber, of which the last half whorl has been removed. From the same locality.

„ 4. Cast of a nearly complete specimen with the body-chamber. From the same locality.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.



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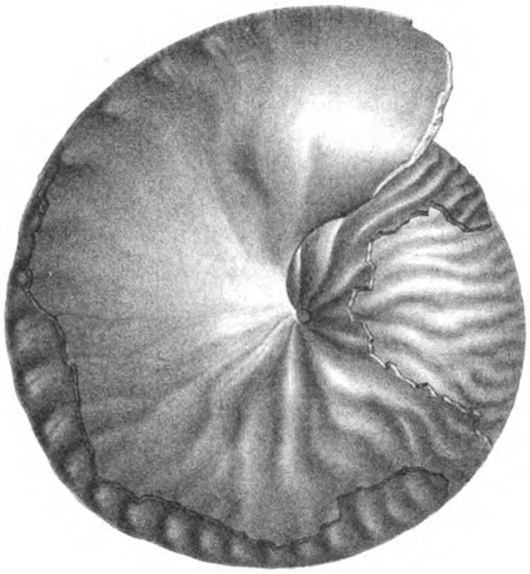

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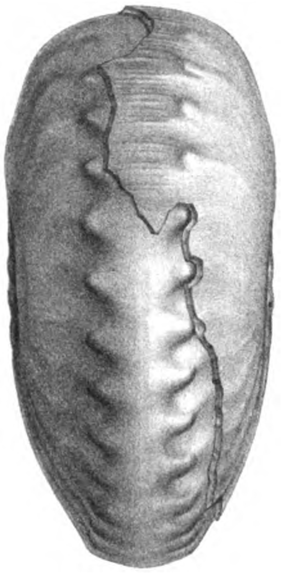

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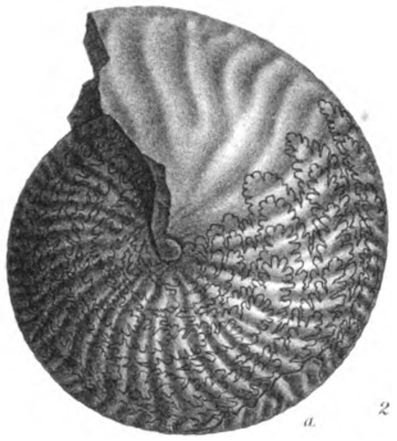

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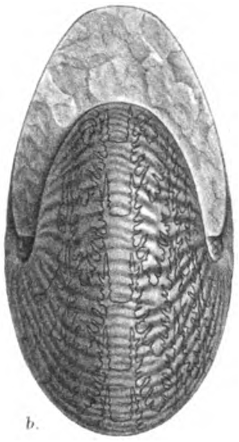

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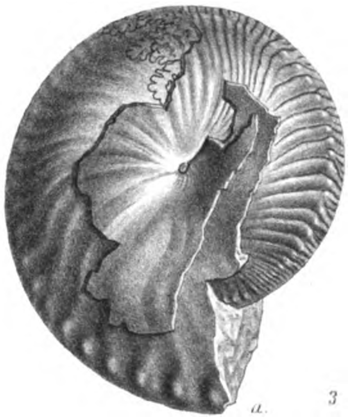
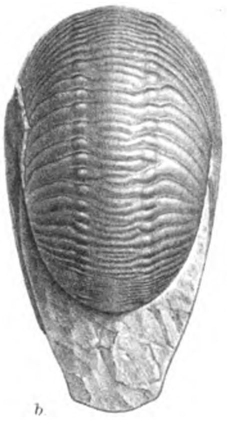


a. 3



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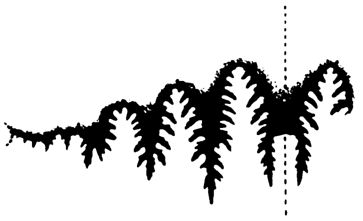

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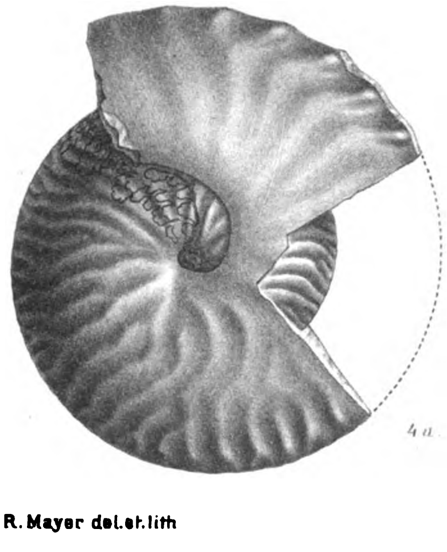

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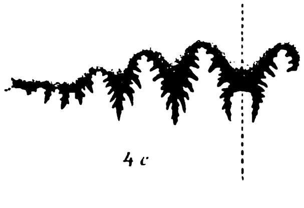

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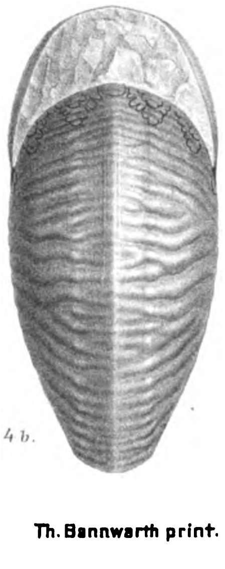


4 b.

R. Mayer del. et lith

Th. Bannwarth print.

PLATE V.

HALORITES.

Fig. 1. **HALORITES PHAONIS**, E. v. Mojs., p. 16. (Cf. Pl. III, Fig. 5.)
TYPE. Full-grown specimen provided with the apertural margin. Cast, from the Halorites Limestone of the Bambanag Section.

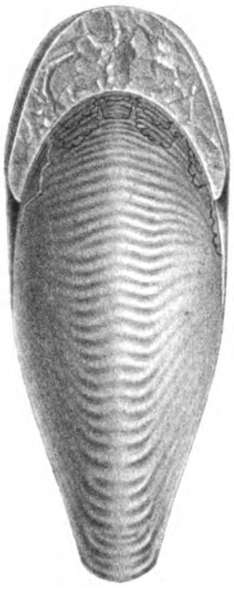
PARAJUVAVITES.

„ 2. **PARAJUVAVITES BLANFORDI**, E. v. Mojs., p. 20. (Cf. Pl. VIII, Figs. 6 and 7.)
VARIETAS OBLIQUA. Cast with an incomplete body-chamber, from the Halorites Limestone of the Bambanag Section.

„ 3. **PARAJUVAVITES LAUKANUS**, E. v. Mojs., p. 22. Calcified full-grown specimen with the test, and nearly completely preserved apertural margin, from Lauka E. G., probably from the Halorites Limestone.

„ 4. **PARAJUVAVITES STERNBERGI**, E. v. Mojs., p. 22. Full-grown specimen with the nearly complete body-chamber. Cast, from the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size and were drawn directly on the stone without the use of a reflector.



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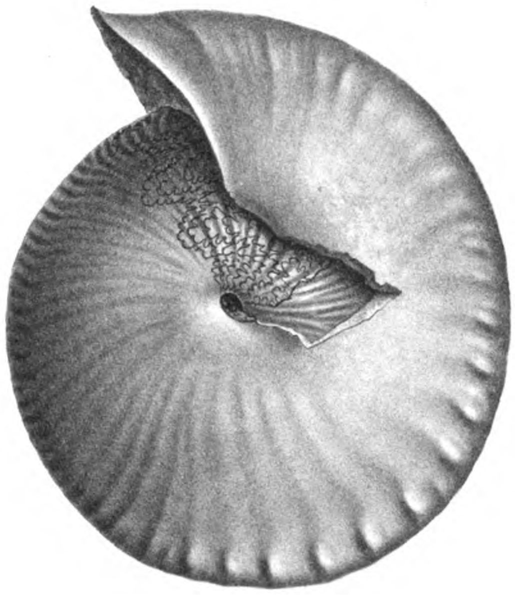

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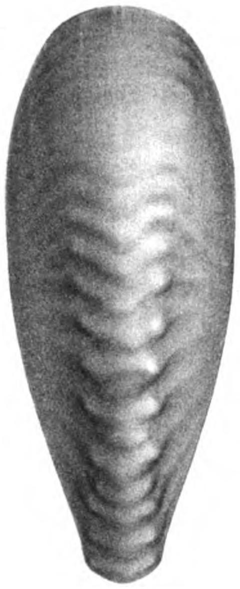

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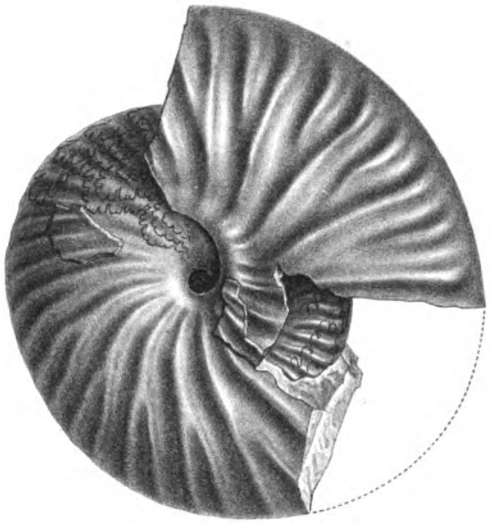

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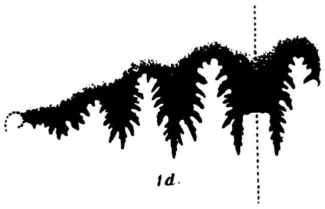

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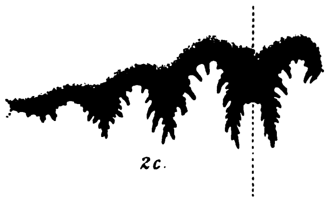

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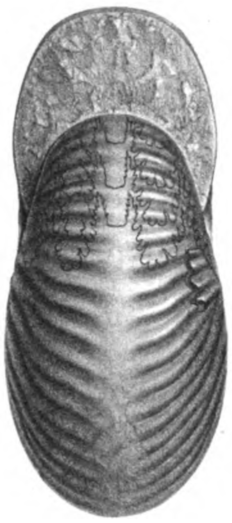

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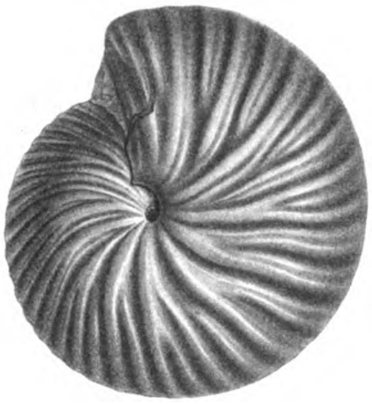

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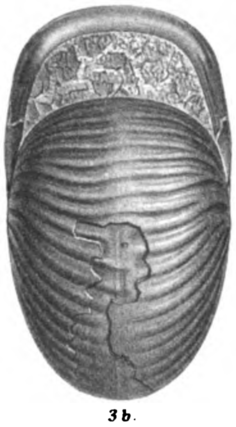

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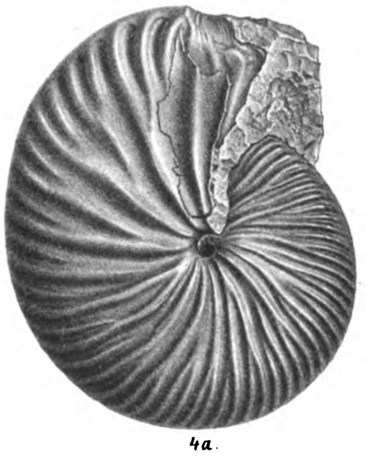

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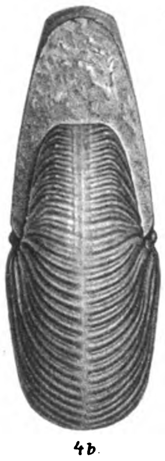


4b

R. Mayer del. et lith.

Th. Bannwarth print.

PLATE VI.

PARAJUVAVITES.

PARAJUVAVITES FEISTMANTELI, Griesbach, p. 24.

Fig. 1. Full-grown specimen, nearly complete. Cast, with some remnants of the test. From the Halorites Limestone of the Bambanag Section.

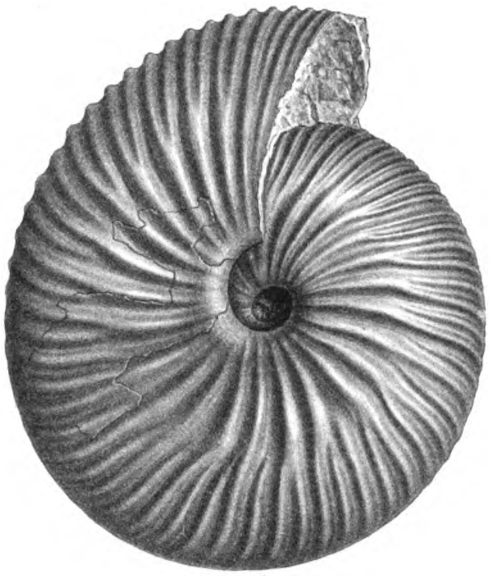
„ 2. Chambered internal cast. From the same locality.

„ 3. Plan of the sutures after Griesbach's original specimen from Rimkin Paiar.

PARAJUVAVITES JACQUINI, E. v. Mojs., p. 25. (Cf. Pl. VII, Figs. 1, 2.)

Figs. 4, 5, 6, 7. Full-grown specimens with the body-chambers preserved; casts with slight portions of test. From the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.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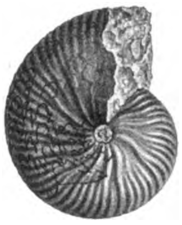
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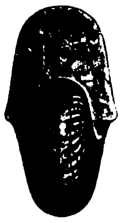
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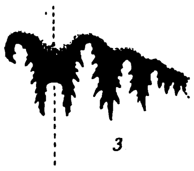
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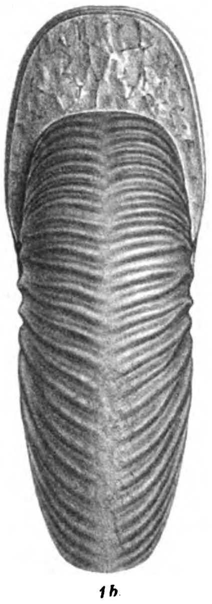
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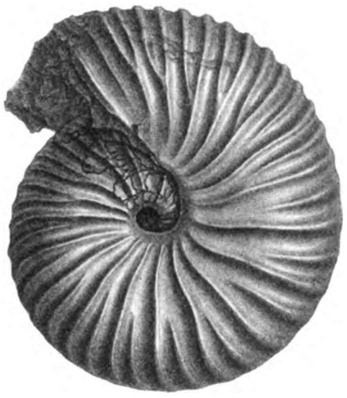
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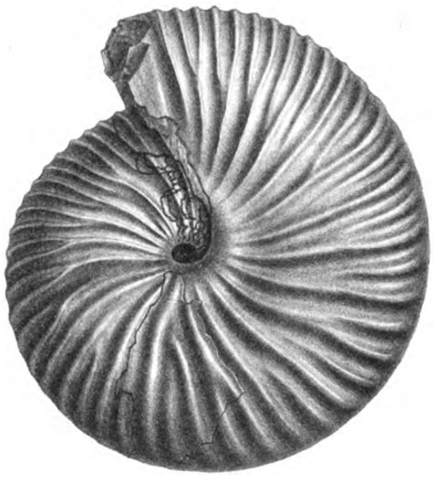
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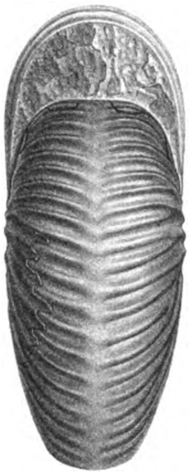
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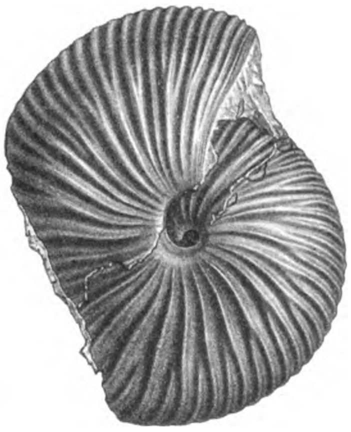
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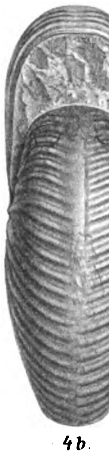
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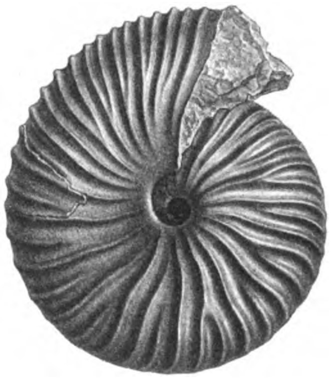
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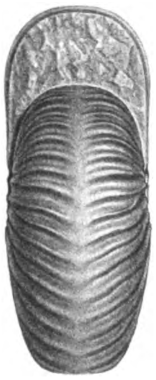
7b.

R. Mayer del.et.lith. Th. Bannwarth print.

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PLATE VII.

PARAJUVAVITES.

PARAJUVAVITES JACQUINI, E. v. Mojs., p. 25. (Cf. Pl. VI, Figs. 4—7.)

Fig. 1. Body-chamber of a full-grown specimen; a cast. From the Halorites Limestone of the Bambanag Section.

„ 2. Full-grown form with the penultimate whorl; a cast. From the same locality.

PARAJUVAVITES TYNDALLI, E. v. Mojs., p. 27.

„ 3. Full-grown specimen with the body-chamber; a cast. From the Halorites Limestone of the Bambanag Section.

„ 4. Penultimate suture-line of a full-grown specimen from the same locality.

PARAJUVAVITES RENARDI, E. v. Mojs., p. 28.

„ 5. Cast of a full-grown complete specimen. From the same locality.

„ 6. PARAJUVAVITES MINOR, E. v. Mojs., p. 30. Full-grown nearly complete specimen, a cast with portions of the test.

Figs. 7, 8 and 9. PARAJUVAVITES LUDOLFI, E. v. Mojs., p. 29. Full-grown specimens (Fig. 8 with the aperture preserved); casts, from the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn on the stone without the use of a reflector.

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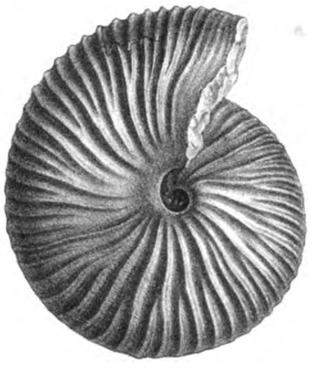
Pl. VII.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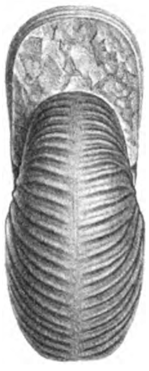
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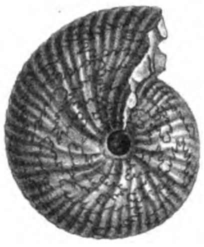
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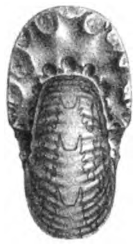
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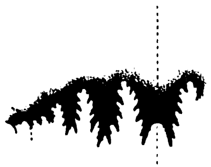
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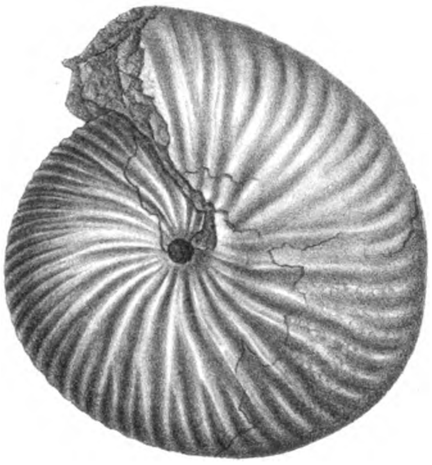
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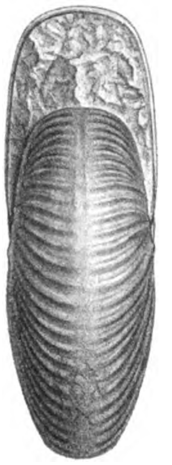
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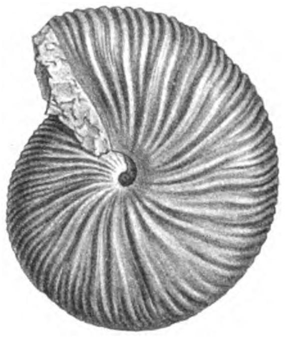
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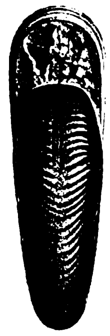
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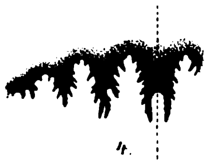
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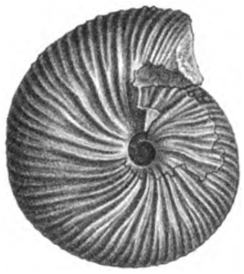
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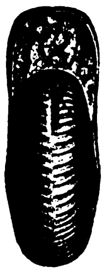
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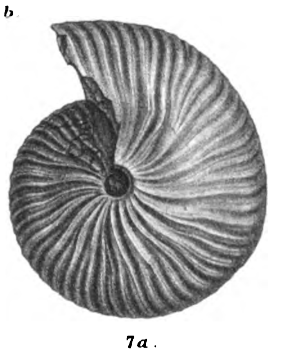
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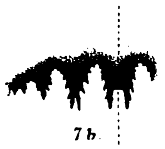
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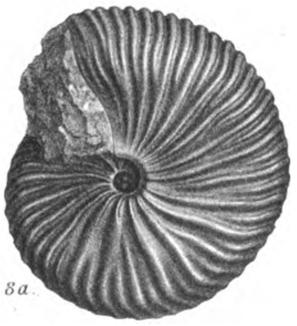
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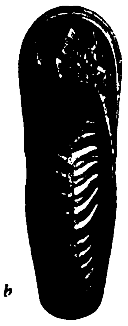
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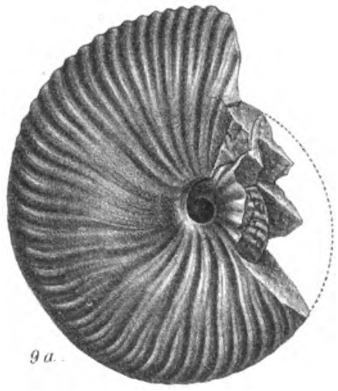
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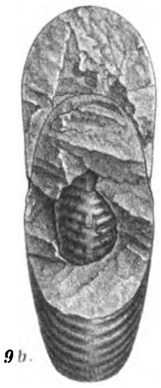
9b

R. Mayer del. et lith.

Th. Bannwarth print.

PLATE VIII.

PARAJUVAVITES.

PARAJUVAVITES BUDDHAICUS, E. v. Mojs., p. 31.

Fig. 1. TYPE. Nearly complete, full-grown specimen with the body-chamber; a cast from the Halorites Limestone of the Bambanag Section.

„ 2. VARIETAS. Full-grown specimen with the body-chamber, not quite complete. A cast from the same locality.

„ 3. Full grown specimen with the anterior part of the body-chamber broken off. A cast with some remnants of the test. From the same locality.

„ 4. Full-grown specimen with the penultimate whorl, of which the last whorl, comprising the body-chamber, has been removed. A cast with portions of the test. From the same locality.

„ 5. Internal cast without the test. From the same locality.

PARAJUVAVITES BLANFORDI, E. v. Mojs., p. 20. (Cf. Pl. V, Fig. 2.)

„ 6. VARIETAS RECTA. Cast of a nearly complete, full-grown specimen, from the Halorites Limestone of Bambanag.

„ 7. A young specimen with the body-chamber; a cast with some portions of the test. From the same locality.

All the figures are of the natural size, and were drawn on the stone without the use of a reflector.

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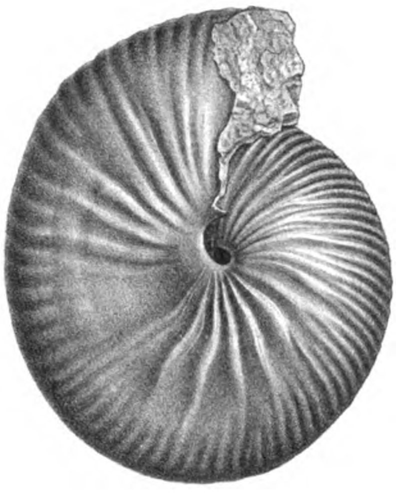
Pl. VIII.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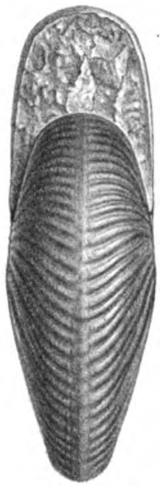
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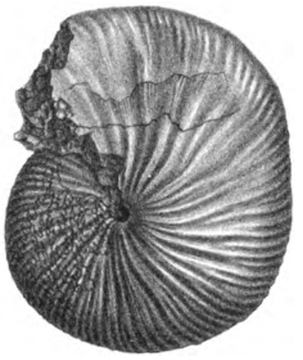
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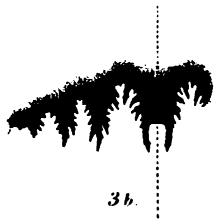
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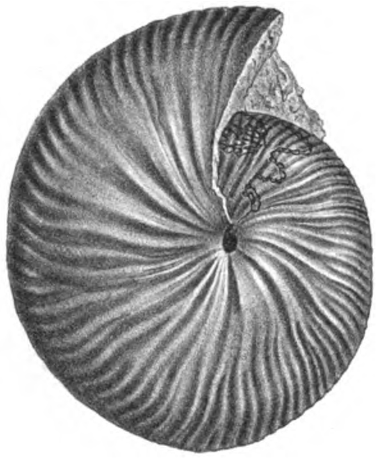
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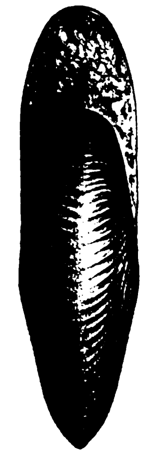
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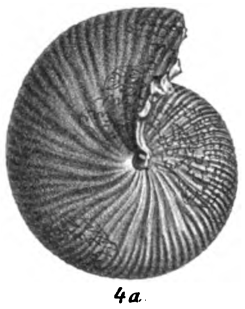
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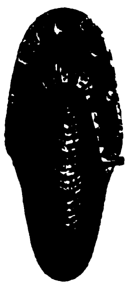
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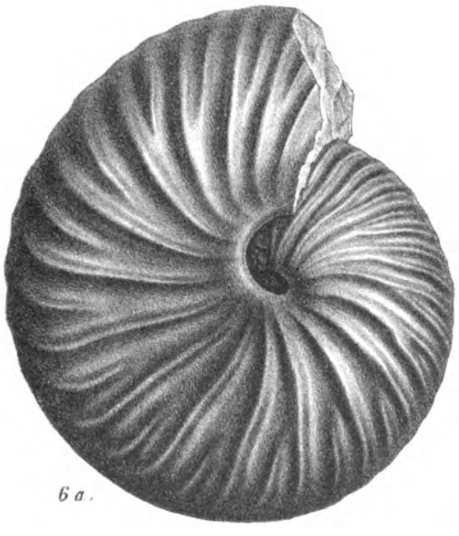
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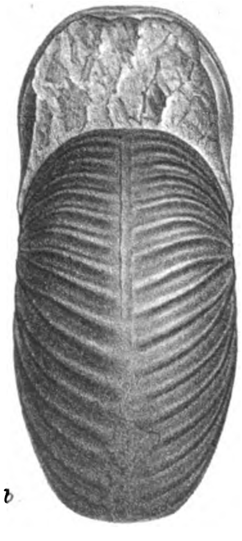
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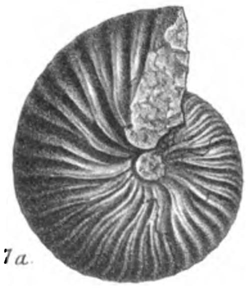
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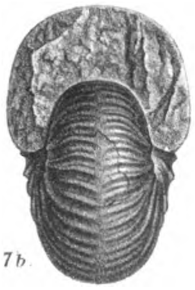

7b.

R. Mayer del.et.lith.

Th. Bannwarth print.

PLATE IX.

PARAJUVAVITES.

Fig. 1. PARAJUVAVITES, nov. f. ind., p. 34. Specimen with an incomplete body-chamber; a cast from the Halorites Limestone of the Bambanag Section.

PARAJUVAVITES STOLICZKAI, E. v. Mojs., p. 33.

„ 2. More finely ribbed variety. Full grown specimen with the body-chamber; a cast from the Halorites Limestone of the Bambanag Section.

„ 3. More coarsely ribbed variety. Cast of a full-grown specimen with the body-chamber. From the same locality.

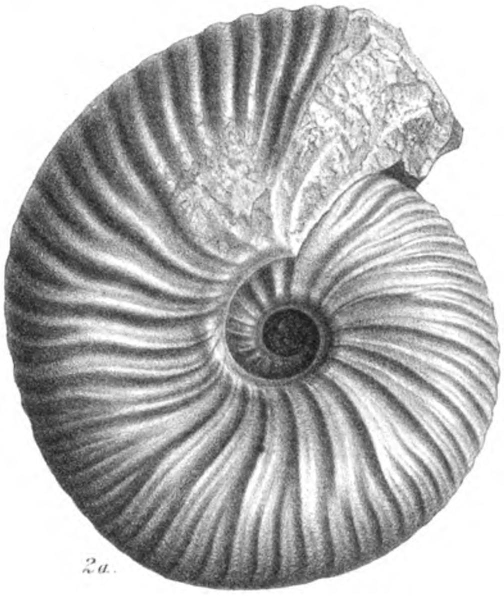
JOVITES.

Figs. 4, 5. JOVITES, nov. f. ind., ex aff. J. BOSNENSIS, p. 18. Fragments with part of the test and with the anterior part of the body-chamber. From the red limestone of the Kiogarh Range, south of Sangcha Talla.

All the figures are of the natural size, and were drawn on the stone without the use of a reflector.

UPPER TRIAS, HIMÁLAYA. VOL:III.

Geological Survey of India. Pl.IX.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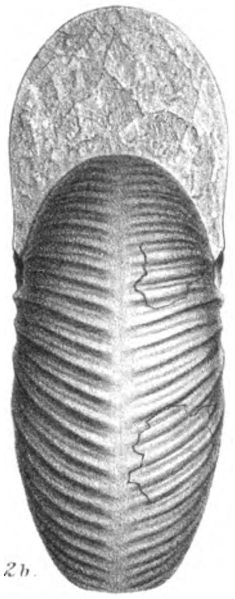
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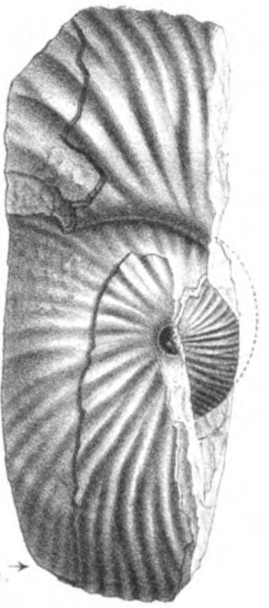
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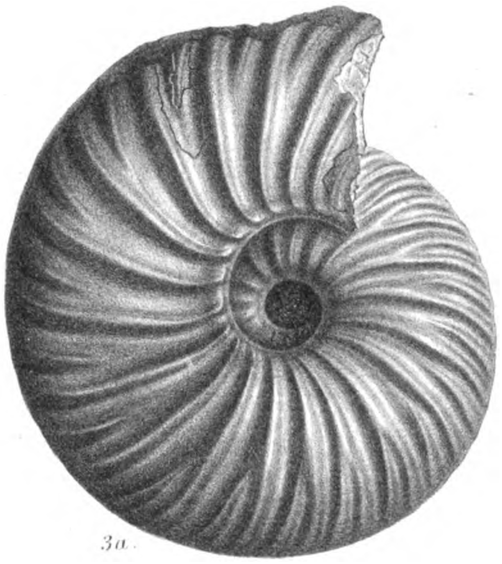
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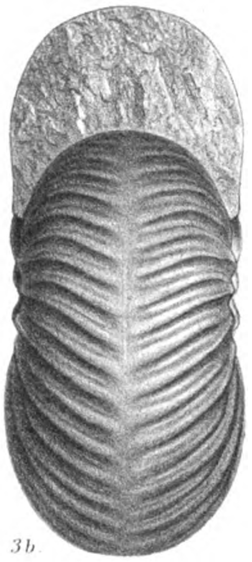
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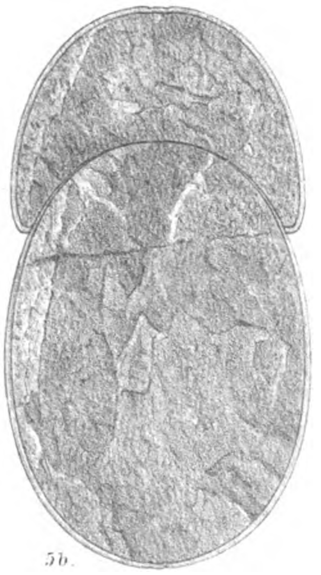
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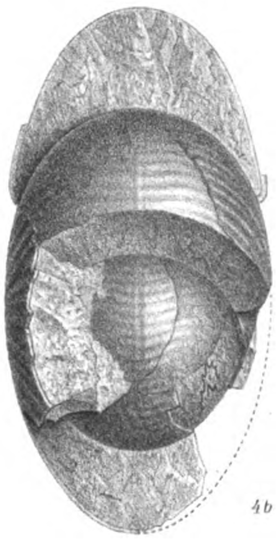
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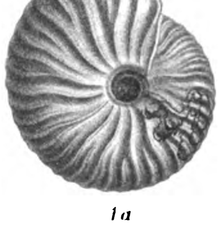
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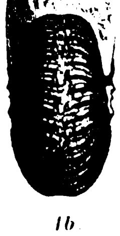
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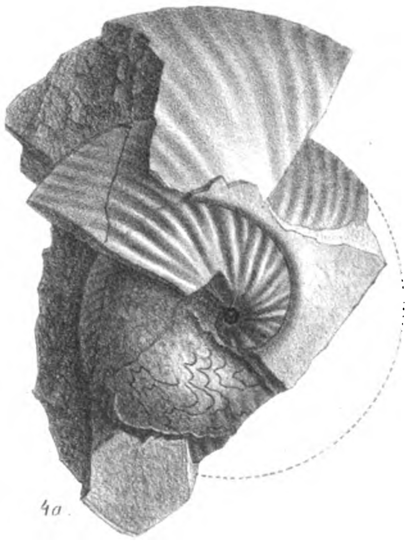
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R. Mayer del.et.lith.

Th. Bannwarth print.

PLATE X.

HERACLITES (GUEMBELITES).

Fig. 1. HERACLITES (GUEMBELITES) JANDIANUS, E. v. Mojs. p. 74. Specimen with the body-chamber; a cast with some portions of the test, from the débris on the eastern slopes of the Iandi Pass. Probably from the Halorites Limestone.

JUVAVITES (GRIESBACHITES).

„ 2. JUVAVITES (GRIESBACHITES) MEDLEYANUS, Stoliczka, p. 38. Chambered cast, from the black limestone, probably belonging to the Daonella beds.

„ 3. JUVAVITES (GRIESBACHITES) HANNI, E. v. Mojs., p. 39. Thicker variety. Calcified fragment; from the Daonella beds of Lauka.

„ 4. J. (G.) HANNI, TYPE. Chambered calcified cast, somewhat distorted. From the same locality.

„ 5. Calcified fragment, from the Daonella beds of the Bambanag Section (bed No. 4).

SAGENITES.

„ 6. SAGENITES, nov. f. ind., p. 42. Chambered fragment, most of it with the test, from the limestone with PINACOCERAS cf. IMPERATOR (No. 6) of the Bambanag Section.

„ 7. SAGENITES, nov. f. ind., p. 43. Chambered fragment, from the bivalve-beds (No. 9) Hochgebirgskalk at the base of the limestone of the high mountains of the Bambanag Section.

PARAJUVAVITES.

„ 8. PARAJUVAVITES BRINTONI, E. v. Mojs., p. 30. Cast of a full-grown specimen with the body-chamber, from the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size and were drawn directly on the stone without the use of a reflector.

UPPER TRIAS, HIMÁLAYA. VOL:III.

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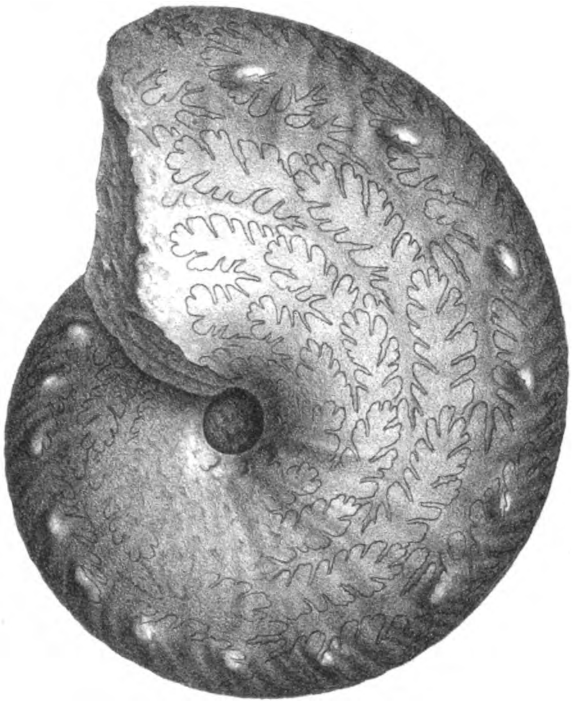
Pl. X.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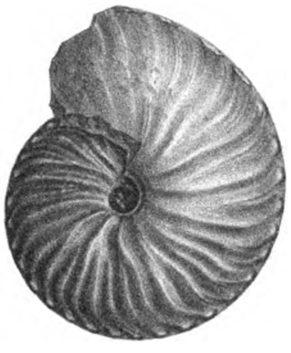
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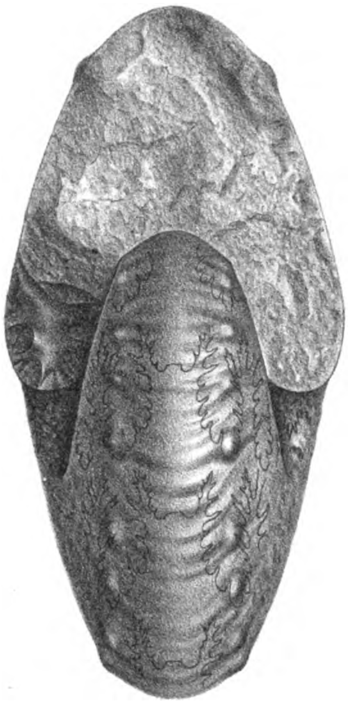
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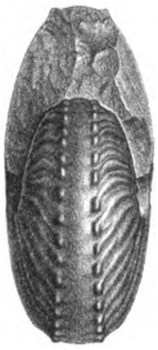
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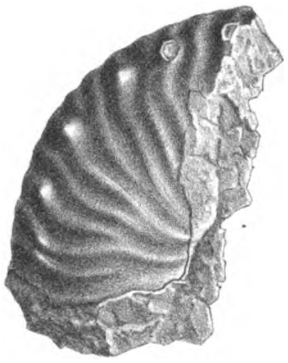
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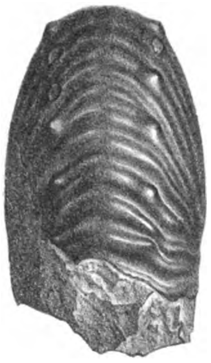
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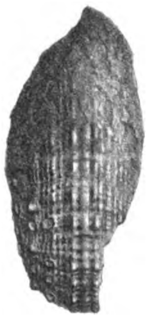
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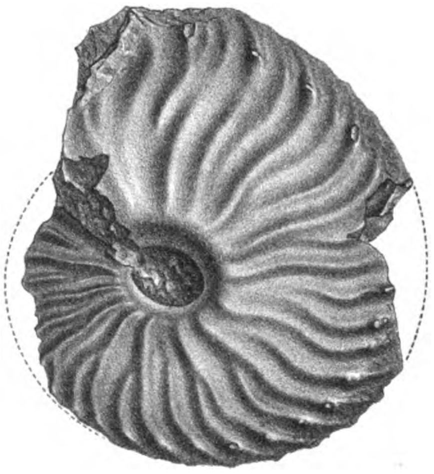
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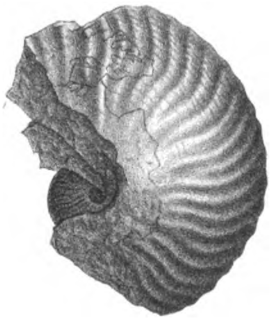
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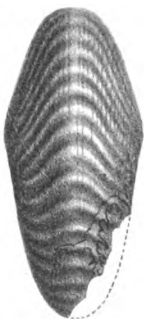
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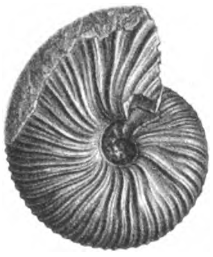
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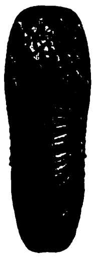
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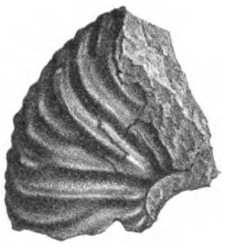
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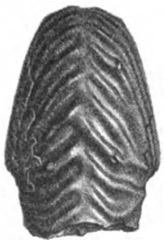
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R. Mayer del. et lith.

Th. Bannwarth print.

PLATE XI.

ANATOMITES (JUVAVITES).

Fig. 1. **ANATOMITES BAMBANAGENSIS**, E. v. Mojs., p. 35. Cast with the anterior half of the last whorl, consisting of the body-chamber; from the Daonella beds of the Bambanag Section.

„ 2. **ANATOMITES CAROLI**, E. v. Mojs., p. 37. Pyritised cast; from the Daonella beds of Rimkin Paiar.

„ 3. **ANATOMITES EUGENII**, E. v. Mojs., p. 36. Pyritised cast; from the Daonella beds of Rimkin Paiar.

TROPITES.

„ 4. **TROPITES**, nov. f. ind. cf. Trop. acutangulus, p. 46. Chambered cast, from the Tropites Limestone of Kalapani.

„ 5. **TROPITES**, ind. cf. Trop. fusobullatus, p. 47. Chambered cast, from the Tropites Limestone of Kalapani.

„ 6. **TROPITES**, nov. f. ind., p. 47. Fragment of a chambered cast, from the Tropites Limestone of Kalapani.

„ 7. **TROPITES**, ind. cf. Tropites discobullatus, p. 48. Chambered cast, from the Tropites Limestone of Kalapani.

„ 8. **TROPITES KALAPANICUS**, E. v. Mojs., p. 45. Cast with a great part of the body-chamber, from the Tropites Limestone of Kalapani.

TRACHYCERAS.

„ 9. **TRACHYCERAS**, nov. f. ind., p. 90. Cast, from the Tropites Limestone of Kalapani.

SAGENITES.

„ 10. **SAGENITES**, nov. f. ind., p. 41. Chambered specimen with badly preserved test, from the Daonella beds of the Bambanag Section.

THETIDITES.

„ 11. **THETIDITES GUIDONIS**, E. v. Mojs., p. 54. Incomplete specimen with the body-chamber and part of the test, from the Halorites Limestone of the Bambanag Section.

„ 12. **THETIDITES HUXLEYI**, E. v. Mojs., p. 52. (Cf. Pl. XII., Figs. 1—4.) Sutures of a specimen, from the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

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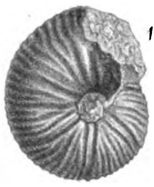
Pl. XI.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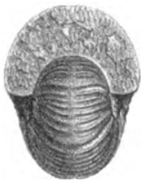
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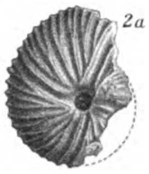
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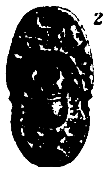
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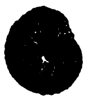
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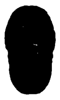
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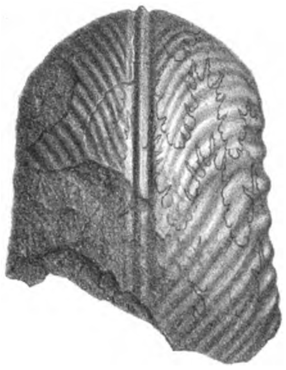
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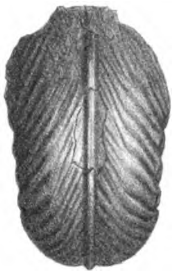
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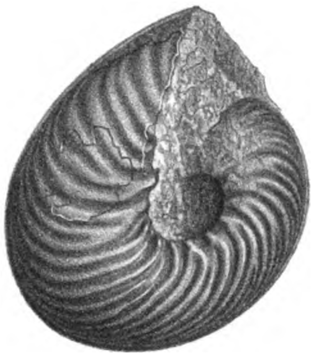
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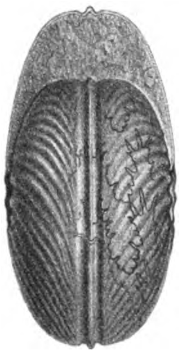
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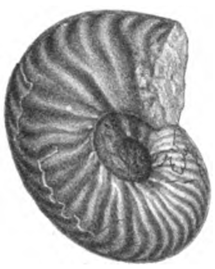
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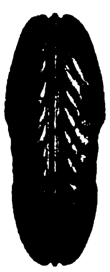
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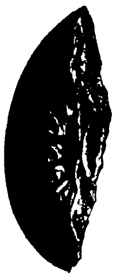
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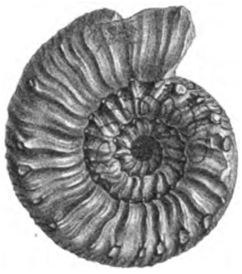
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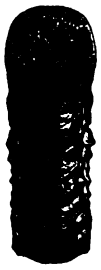
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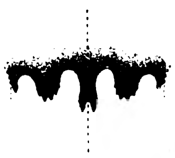
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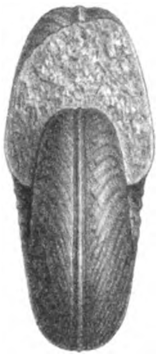
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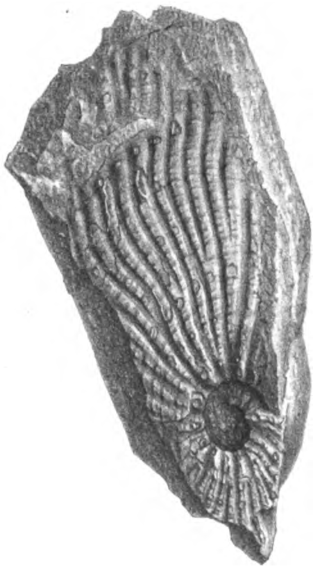
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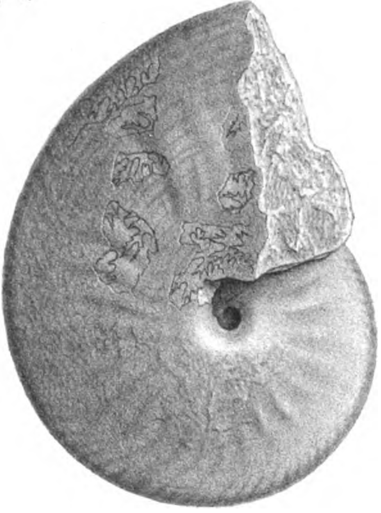
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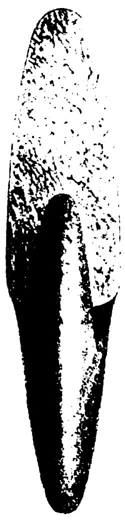
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R. Mayer del. et lith.

Th. Bannwarth print.

PLATE XII.

THETIDITES.

THETIDITES HUXLEYI, E. v. Mojs., p. 52. (Cf. Pl. XI., Fig. 12.)

Fig. 1. Specimen with nearly complete body-chamber. From the Halorites Limestone of the Bambanag Section.

„ 2. Specimen with the body-chamber and part of the test. From the same locality.

„ 3. Incomplete specimen with the body-chamber and part of the test. From the same locality.

„ 4. Full-grown individual with part of the test and a portion of the body-chamber. From the same locality.

HELICTITES.

„ 5. HELICTITES ATALANTA, E. v. Mojs., p. 55. Specimen with the body-chamber and portions of the test. From the Halorites Limestone of the Bambanag Section.

STEINMANNITES.

„ 6. STEINMANNITES CLIONITOIDES, E. v. Mojs., p. 68. Chambered fragment with remnants of the test on the inner whorls. From the Halorites Limestone of the Bambanag Section.

„ 7. STEINMANNITES DESIDERII, E. v. Mojs., p. 69. Chambered fragment with portions of the test on the inner whorls. From the Halorites Limestone of the Bambanag Section.

STEINMANNITES NOETLINGI, E. v. Mojs., p. 70.

„ 8. Specimen with the body-chamber and parts of the test. From the Halorites Limestone of the Bambanag Section.

„ 9. VARIETAS. Specimen with the body-chamber, and part of the test. From the same locality.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

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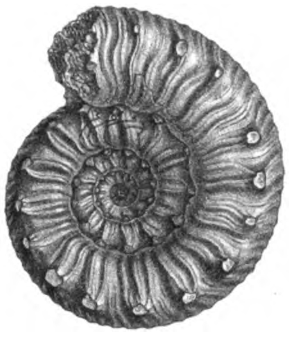

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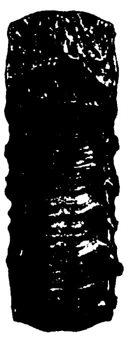

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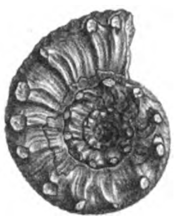

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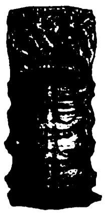

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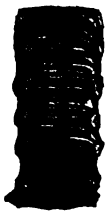

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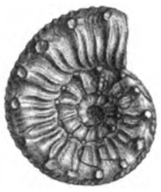

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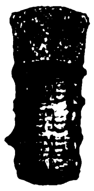

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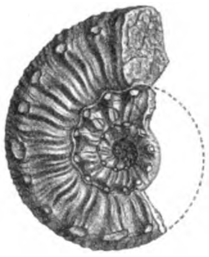

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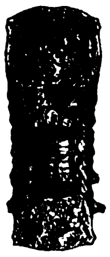

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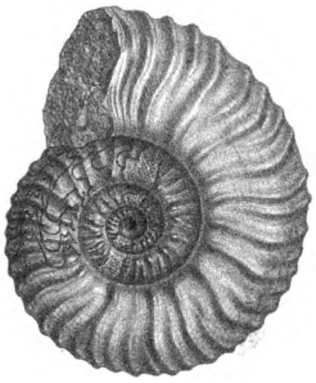

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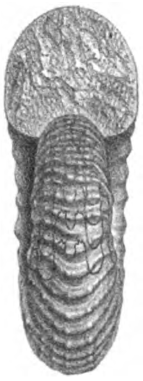

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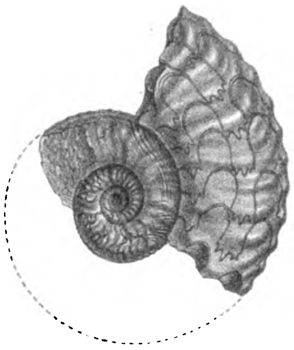

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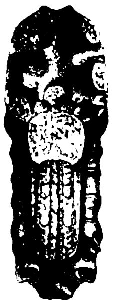

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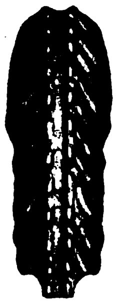

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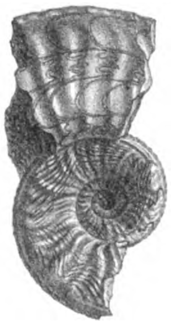

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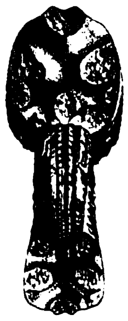

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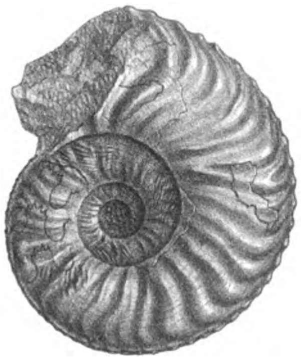

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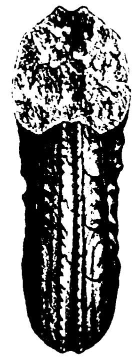

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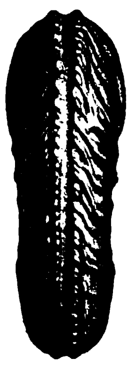

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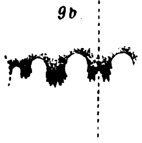

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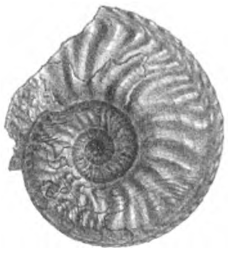


R. Mayer del. et lith.

Th. Bannwarth print.

PLATE XIII.

STEINMANNITES.

Fig. 1. STEINMANNITES UNDULATOSTRIATUS, E. v. Mojs., p. 66. Specimen with the beginning of the body-chamber and the test only on the inner whorls. From the Halorites Limestone of the Bambanag Section.

„ 2. STEINMANNITES LUBBOCKI, E. v. Mojs., p. 71. Chambered specimen with part of the test. From the Halorites Limestone of the Bambanag Section.

„ 3. Specimen of the body-chamber; a cast, from the same locality.

CLIONITES.

CLIONITES WOODWARDI, E. v. Mojs., p. 61.

„ 4. Type. Specimen, with part of the test and with the beginning of the body-chamber. From the Halorites Limestone of the Bambanag Section.

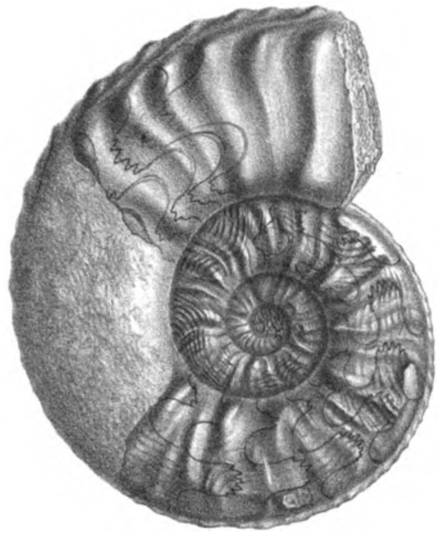
„ 5. VARIETAS CRASSA. Chambered fragment, most of it a cast. From the same locality.

„ 6. Type ⎫ CLIONITES SALTERI, E. v. Mojs., p. 62.
„ 7. Varietas ⎭ Chambered casts. From the Halorites Limestone of the Bambanag Section.

„ 8. CLIONITES ABERRANS, E. v. Mojs., p. 63. Fragment with the test and with part of the body-chamber. From the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

Geological Survey of India. UPPER TRIAS, HIMÁLAYA. VOL:III. Pl. XIII.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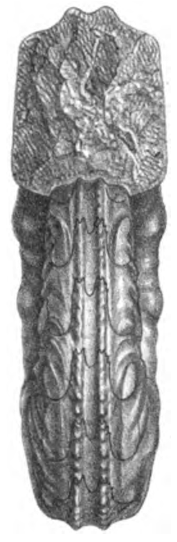
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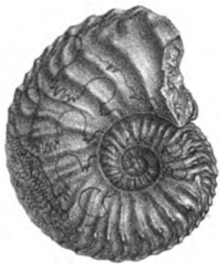
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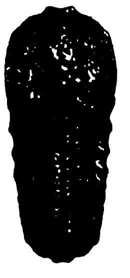
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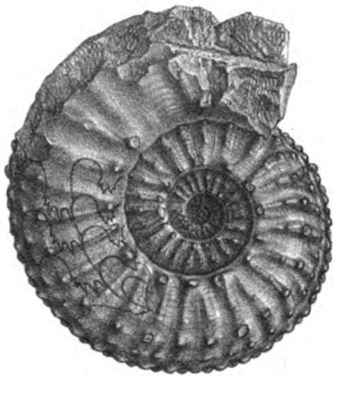
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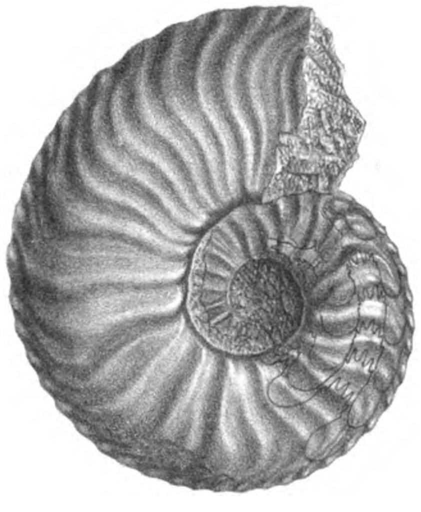
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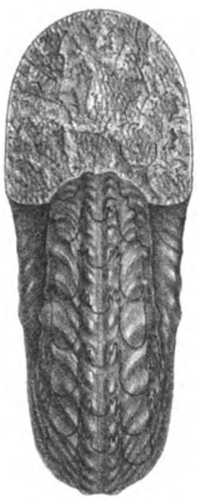
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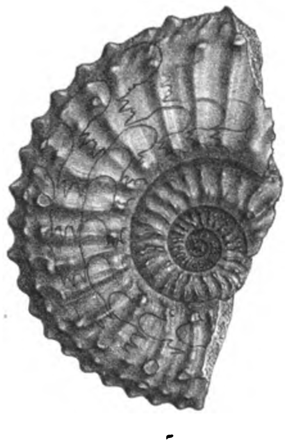
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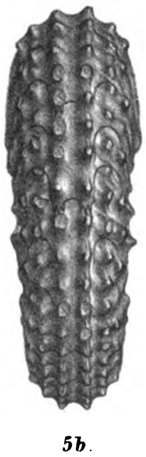
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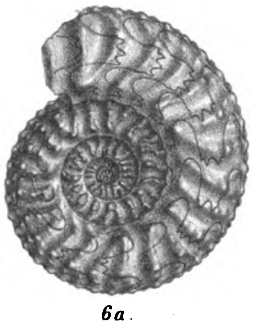
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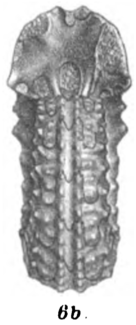
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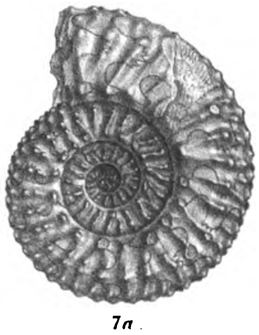
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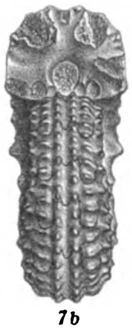
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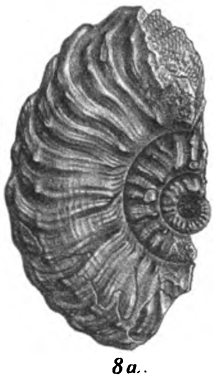
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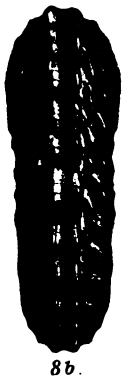

8b.

R. Mayer del. et. lith.

Th. Bannwarth print.

PLATE XIV.

CLIONITES.

Fig. 1. CLIONITES HUGHESI, E. v. Mojs., p. 64. Type. Specimen with the body-chamber, most of it a cast. From the Halorites Limestone of the Bambanag Section.

Figs. 2, 3. Cl. Hughesi, Varietates. Specimens with the body-chamber and slight remnants of the test. From the same locality.

Fig. 4. CLIONITES, nov. f. ind., p. 65. Specimen with the beginning of the body-chamber, most of it a cast. From the Halorites Limestone of the Bambanag Section.

" 5. CLIONITES SPINOSUS, E. v. Mojs., p. 66. Specimen with the body-chamber and part of the test. From the Halorites Limestone of the Bambanag Section.

ARPADITES.

" 6. ARPADITES RIMKINENSIS, E. v. Mojs., p. 59. Specimen, with the test. From the Crinoidal Limestone, with Trachyceras tibeticum from Rimkin Paiar.

" 7. ARPADITES LISSARENSIS, E. v. Mojs., p. 60. Fragment, with the test and with a part of the body-chamber. From grey limestone (with Joannites cf. cymbiformis) of the Lissar Valley.

DITTMARITES.

" 8. DITTMARITES HINDEI, E. v. Mojs., p. 60. Chambered specimen, with part of the test. From the Halorites Limestone of the Bambanag Section.

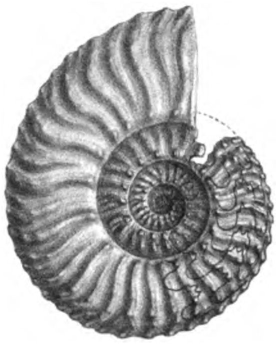
ANATIBETITES.

" 9. ANATIBETITES KELVINI, E. v. Mojs., p. 80. Specimen with the body-chamber; a cast from the Halorites Limestone of the Bambanag Section.

THISBITES.

" 10. THISBITES (?) MELEAGRI, E. v. Mojs., p. 56. Specimen with the test. From the black limestone of Tera Gadh, N. of Kalapani.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.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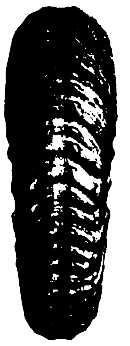
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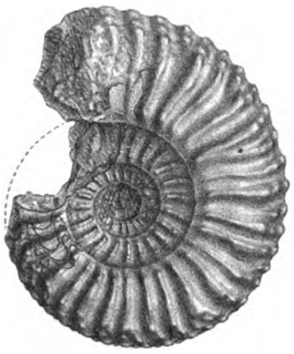
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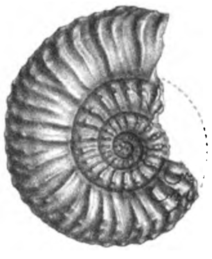
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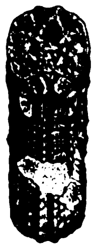
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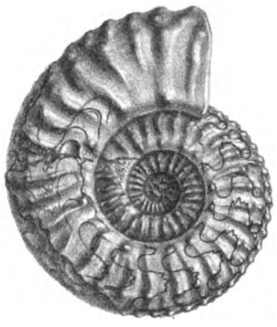
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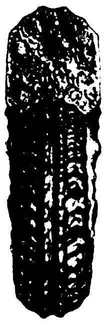
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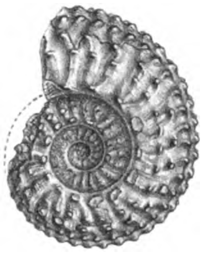
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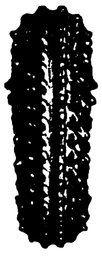
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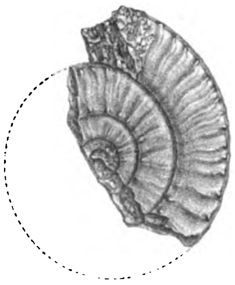
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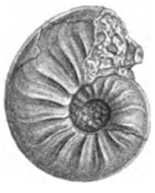
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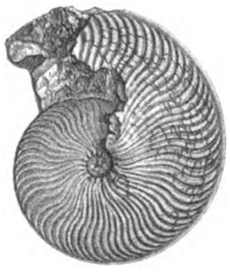
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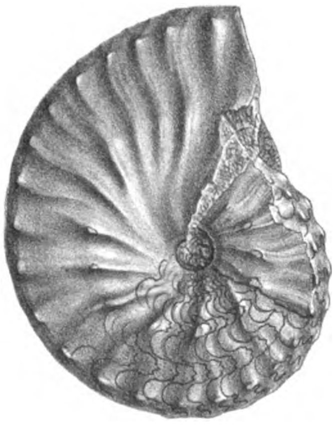
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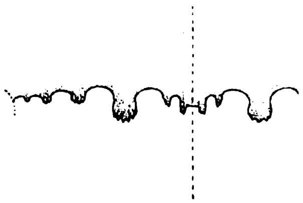
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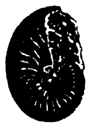
10a.

10b

R. Mayer del. et lith.

Th. Bannwarth print.

PLATE XV.

PARATIBETITES.

Fig. 1. PARATIBETITES BERTRANDI, E. v. Mojs., p. 82. Chambered cast. From the Halorites Limestone of the Bambanag Section.

„ 2. PARATIBETITES GEIKIEI, E. v. Mojs., p. 83. Chambered specimen, with some portions of the test. From the Halorites Limestone of the Bambanag Section.

PARATIBETITES ADOLPHI, E v. Mojs., p. 84.

„ 7. Specimen, with the body-chamber and some remnants of the test. From the Halorites Limestone of the Bambanag Section.

„ 8. Chambered specimen, with part of the test. From the same locality.

„ 9. Varietas. Chambered specimen, with part of the test. From the same locality.

„ 10. Varietas. Specimen, with the body-chamber and part of the test. From the same locality.

TIBETITES.

TIBETITES RYALLI, E. v. Mojs., p. 77.

„ 3. Specimen, with the beginning of the body-chamber and part of the test. From the Halorites Limestone of the Bambanag Section.

„ 4. Fragment of the body-chamber, with part of the test. From the same locality.

„ 5. TIBETITES MURCHISONI, E. v. Mojs., p. 78. Specimen, with the body-chamber and part of the test. From the Halorites Limestone of the Bambanag Section.

„ 6. TIBETITES PERRIN SMITHI, E. v. Mojs., p. 79. Specimen with the body-chamber and portions of the test. From the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector

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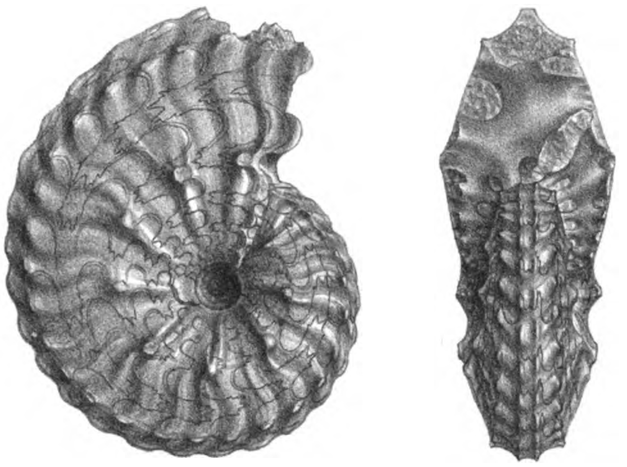
Pl. XV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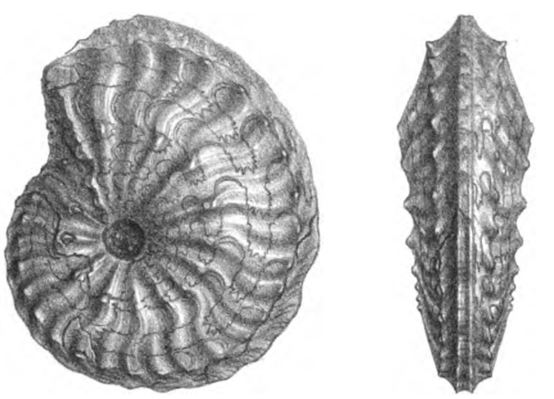
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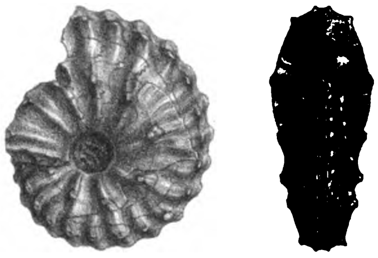
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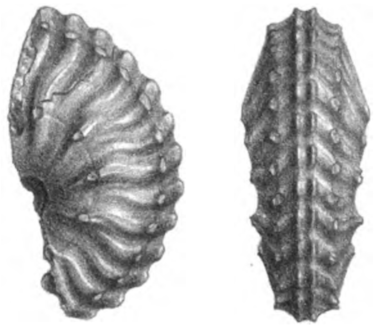
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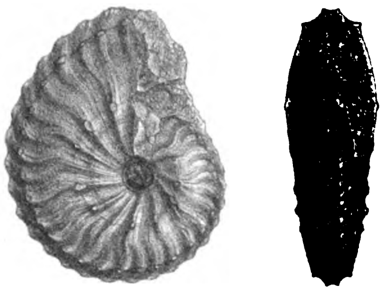
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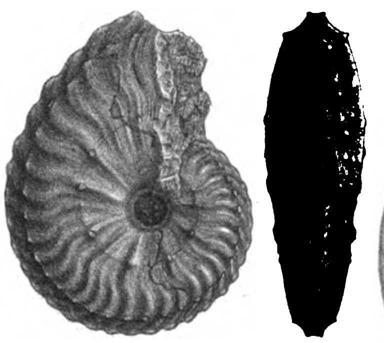
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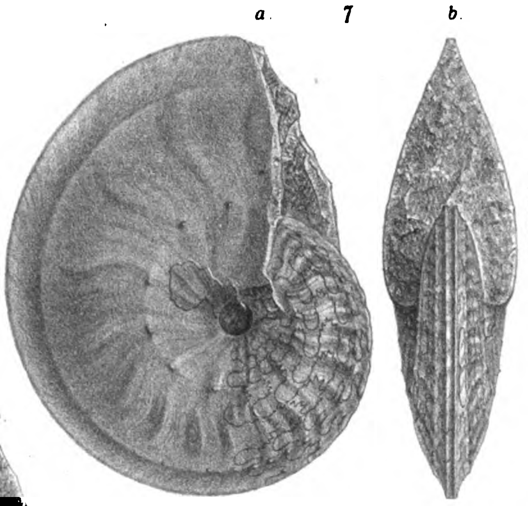
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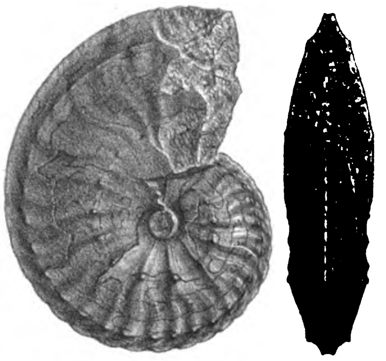
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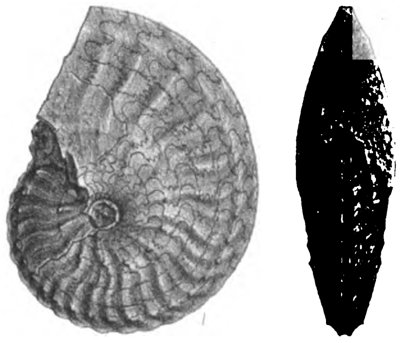
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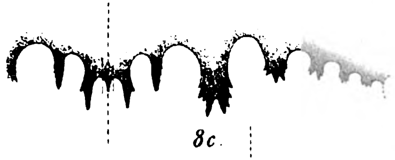
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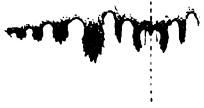
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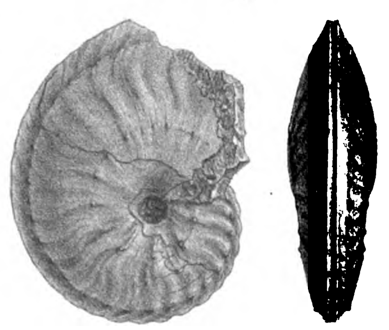
10.

R. Mayer del. et lith.

Th. Bannwarth print.

PLATE XVI.

PARATIBETITES.

PARATIBETITES ANGUSTOSELLATUS, E. v. Mojs., p. 86.

Fig. 1. Chambered cast. From the Halorites Limestone of the Bambanag Section.

„ 2. Chambered specimen with part of the test. From the same locality.

„ 3. VARIETAS. Chambered specimen, with part of the test. From the same locality.

„ 4. Plan of the sutures from a type specimen. From the same locality.

PARATIBETITES TORNQUISTI, E. v. Mojs., p. 87.

„ 5. Chambered cast from the Halorites Limestone of the Bambanag Section.

HAUERITES.

HAUERITES (?), nov. f. ind., p. 88.

„ 6. Plan of the sutures of a fragment. From the black arenaceous limestone of the bed No. 6 of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

Geological Survey of India.

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Pl. XVI.

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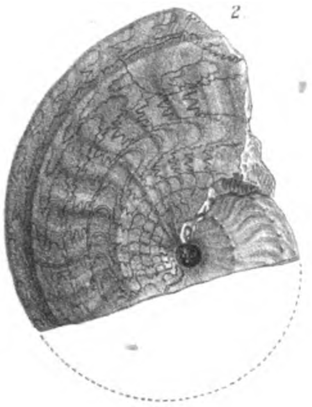

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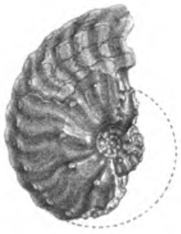

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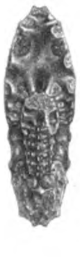

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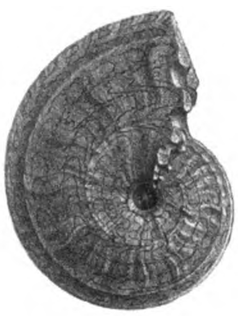

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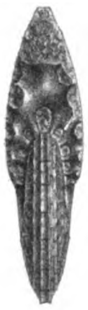

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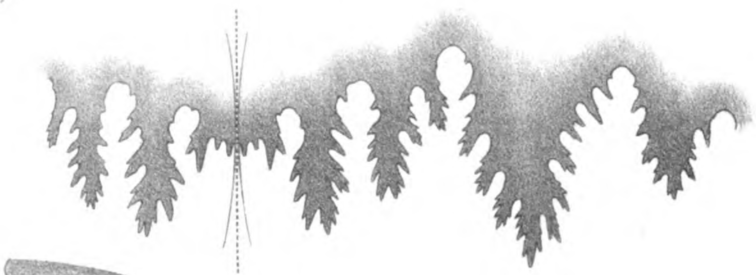

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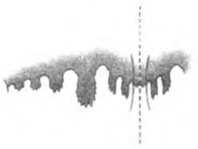

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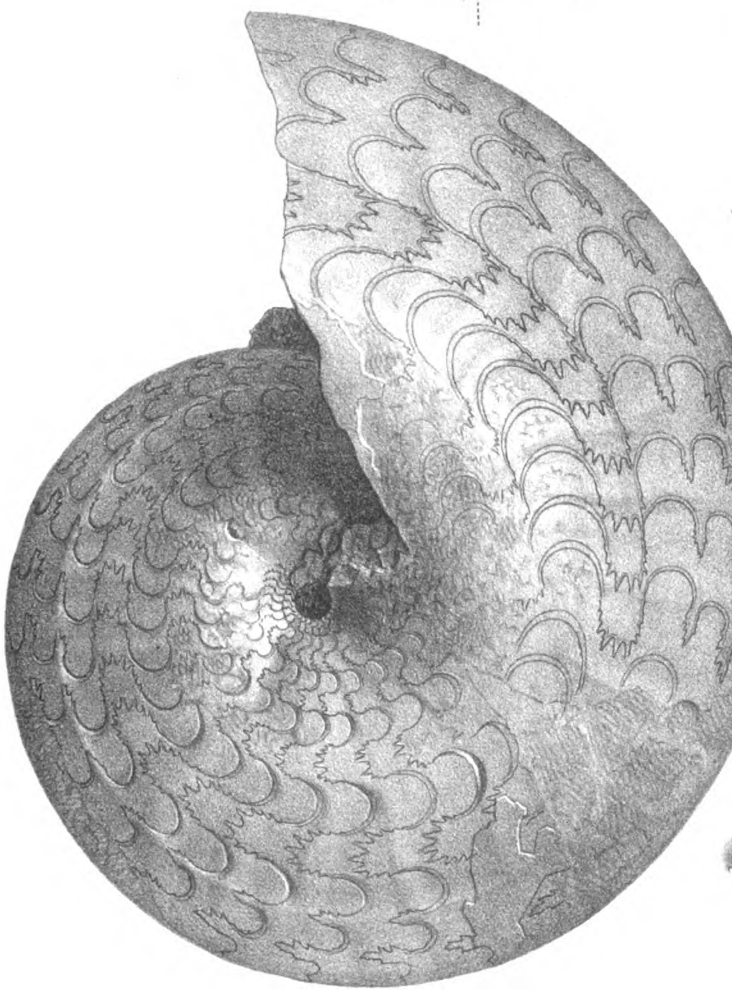

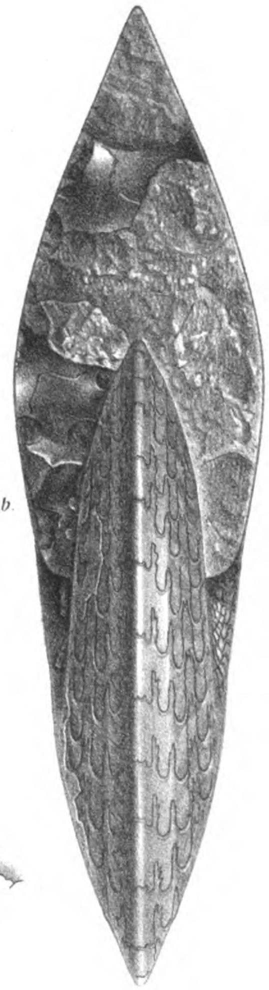

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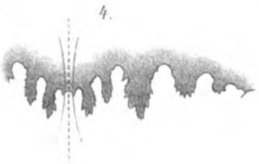

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PLATE XVII.

SANDLINGITES.

SANDLINGITES NICOLAI, E. v. Mojs., p. 91.

Fig. 1. Chambered cast. From the Halorites Limestone of the Bambanag Section.

„ 2. External view of the cast with the body-chamber. From the same locality.

SANDLINGITES ARCHIBALDI, E. v. Mojs., p 92.

„ 3. Specimen with the body-chamber, without the test on the outer whorl. From the Halorites Limestone of the Bambanag Section.

„ 4. VARIETAS. Specimen with the body-chamber, without the test on the outer whorl. From the same locality.

„ 5. Chambered cast. From the same locality.

GROUP OF PROTRACHYCERATA VALIDA.

„ 6. PROTRACHYCERAS RALPHUANUM, E. v. Mojs., p. 89. Chambered specimen with the test, from the black limestone, facing the Ralphu Glacier.

GROUP OF TRACHYCERATA DUPLICA.

„ 7. TRACHYCERAS TIBETICUM, E. v. Mojs., p. 90. Cast with the beginning of the body-chamber, from the crinoidal limestone of Rimkin Paiar.

GROUP OF SIRENITES ARGONAUTÆ.

SIRENITES ELEGANS, E. v. Mojs., p. 93.

„ 8. Chambered cast, from the Halorites Limestone of the Bambanag Section.

„ 9. Chambered fragment with the test. From the same locality.

„ 10. SIRENITES RICHTERI, E. v. Mojs., p. 94. Chambered fragment with the test, from the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

UPPER TRIAS, HIMÁLAYA. VOL:III.

Geological Survey of India.

Pl. XVII.

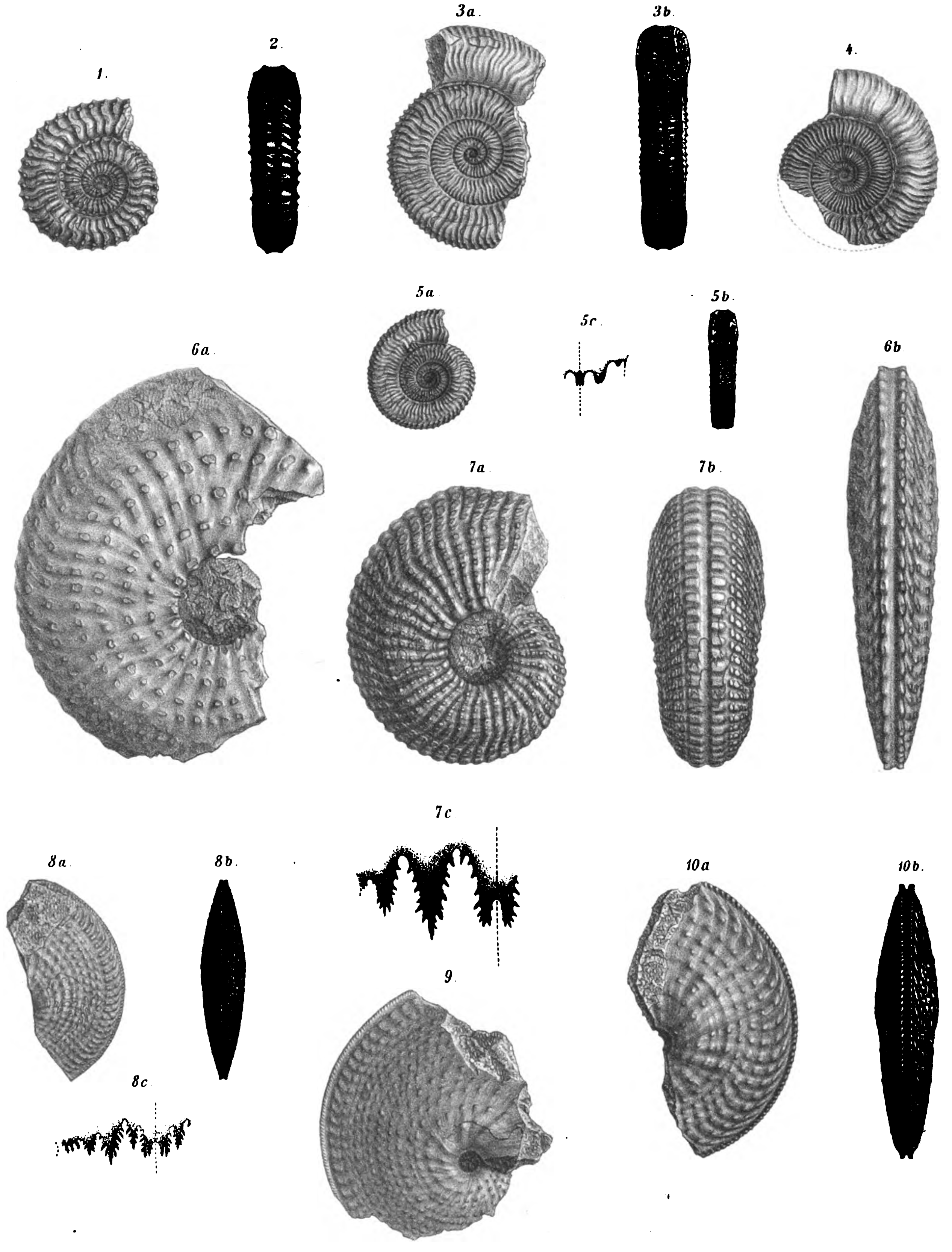

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PLATE XVIII.

BAMBANAGITES.

BAMBANAGITES SCHLAGINTWEITI, E. v. Mojs., p. 107.

Fig. 1. Specimen with nearly complete body-chamber and part of the test. From the Halorites Limestone of the Bambanag Section.

" 2. Chambered specimen with part of the test. From the same locality.

Figs. 3, 4, 5 and 6. BAMBANAGITES DIENERI, E. v. Mojs., p. 108. Specimens with body-chamber and with portions of the test. From the Halorites Limestone of the Bambanag Section.

PINACOCERAS.

PINACOCERAS PARMA, E. v. Mojs., p. 105.

Fig. 7. Chambered specimen with sutures indicated on the figure and remnants of the test. From the Halorites Limestone of the Bambanag Section.

" 8. Plan of the suture-line of a specimen from the same locality.

PLACITES.

" 9. PLACITES, ind. ex. aff. Pl. peraucti, p. 111. Fragment of a chambered specimen. From the upper Daonella beds of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

Geological Survey of India.

UPPER TRIAS, HIMÁLAYA. VOL: III.

Pl. XVIII.

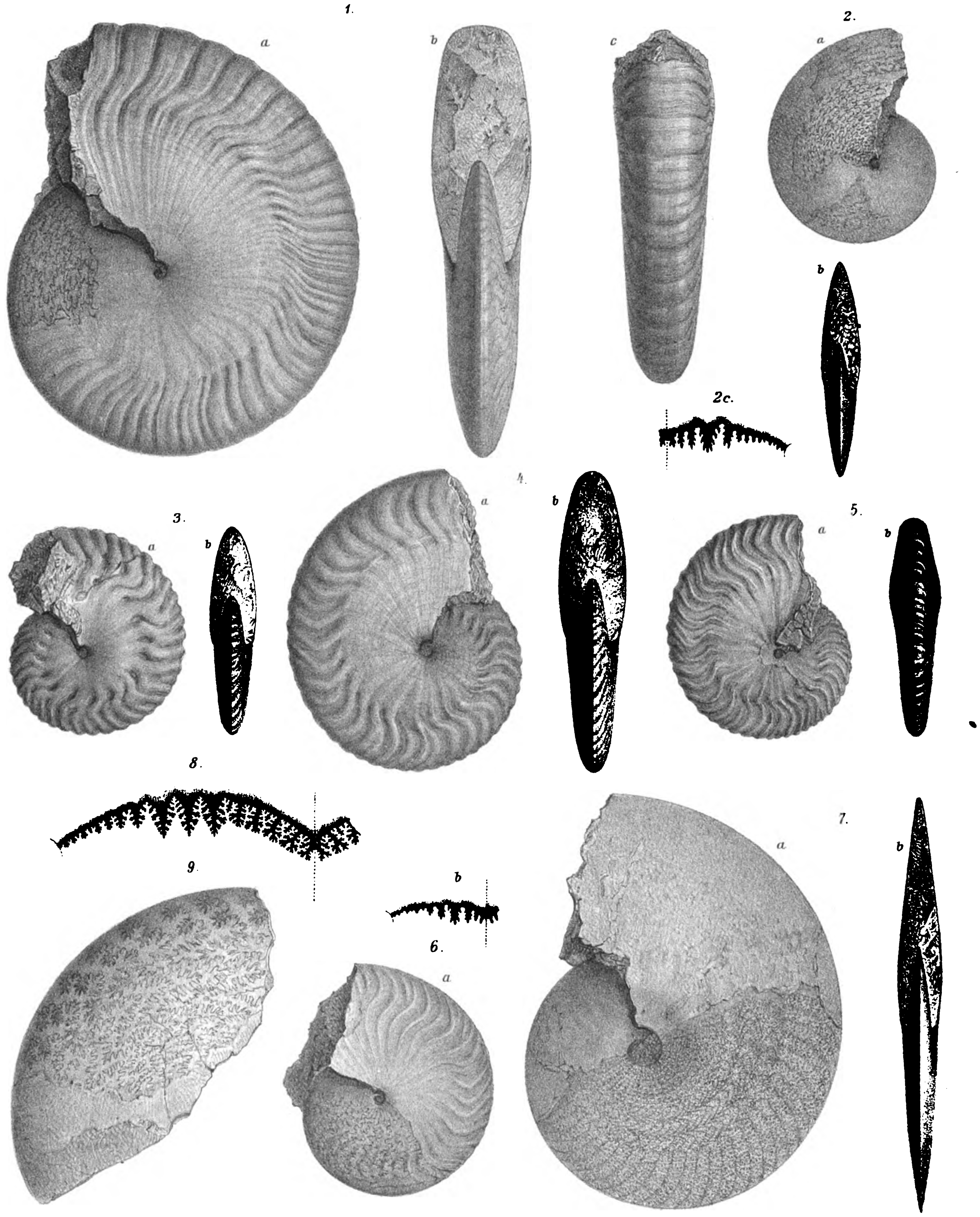

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PLATE XIX.

PINACOCERAS.

Fig. 1. **PINACOCERAS**, sp. ind., ex aff. P. Imperatoris, p. 106. Fragment of a chambered cast from the Limestone complex No. 6 of the Bambanag Section. The umbilical margin is visible on the lower part of the figure by a slight displacement.

PLACITES.

" 2. **PLACITES OLDHAMI**, E. v. Mojs., p. 111. Chambered specimen, with remnants of the test. From the Daonella beds of Lauka.

Figs. 3, 4, 5. **PLACITES SAKUNTALA**, E. v. Mojs., p. 112. Chambered forms with part of the test. From the Halorites Limestone of the Bambanag Section (3 d, sutures at the beginning, 3 c, at the end of the last whorl).

PHYLLOCERAS.

Fig. 6. **PHYLLOCERAS (MOJSVÁRITES) EBNERI**, E. v. Mojs., p. 116. Chambered specimen, with part of the test. From the Daonella beds of Lauka.

MOJSVÁRITES.

" 7. **MOJSVÁRITES EUGYRUS**, E. v. Mojs., p. 114. Chambered specimen, with the test. From the Daonella beds of the Bambanag Section.

PTYCHITES.

PTYCHITES POSTHUMUS, E. v. Mojs., p. 117.

" 8. Chambered internal cast without the test. From the black limestone facing the Ralphu Glacier.

" 9. Specimen with the body-chamber, most of it without the test. From the same locality.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

UPPER TRIAS, HIMALAYA. VOL:III.

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Pl. XIX

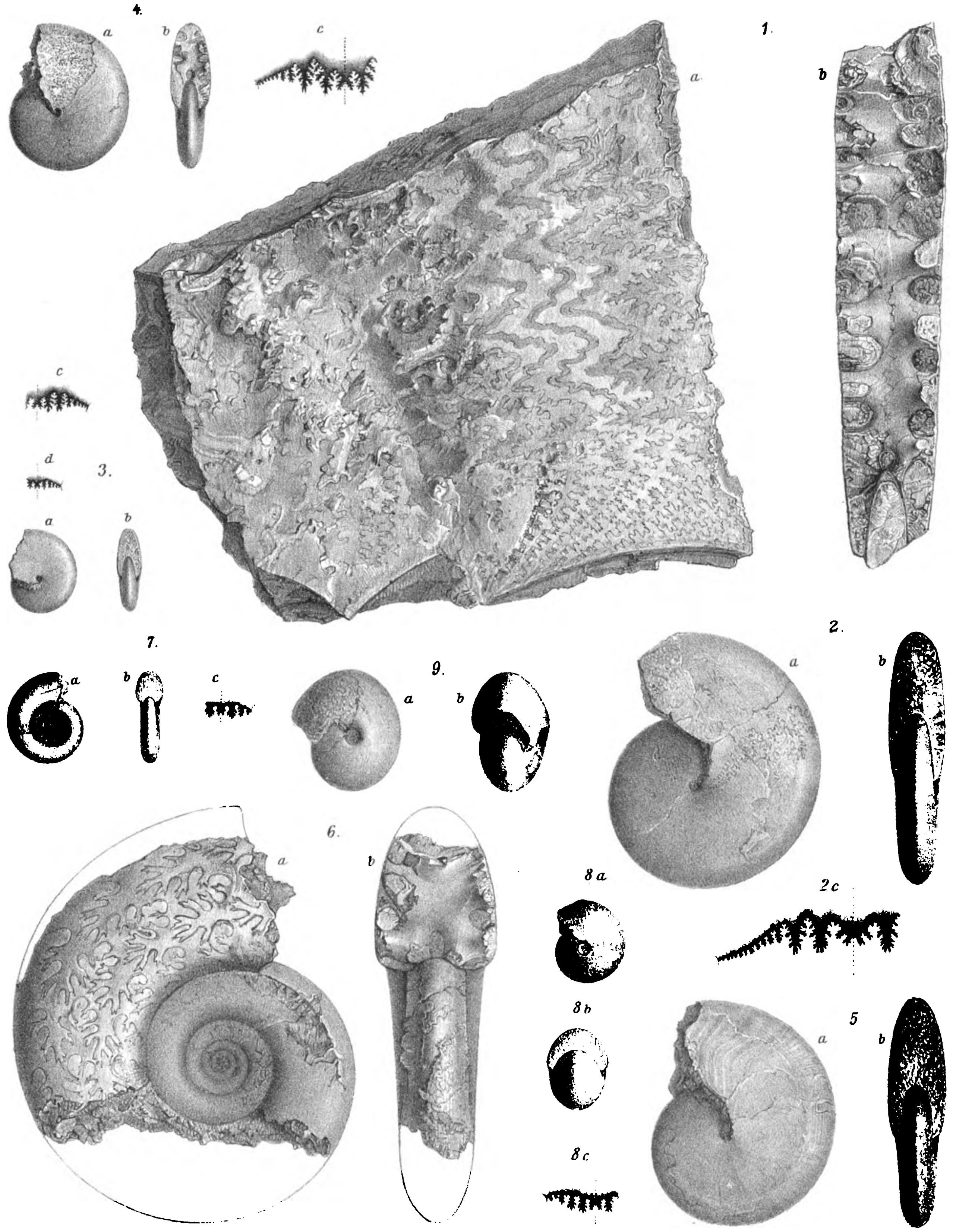

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PLATE XX.

PARACLADISCITES.

Fig. 1. PARACLADISCITES INDICUS, E. v. Mojs., p. 103. Chambered cast, with some remnants of the test. From the black limestone of Kuling (Spiti).

CLADISCITES.

„ 2. CLADISCITES SUBARATUS, E. v. Mojs., p. 102. Chambered fragment, with the test. From the black limestone of the Daonella beds of Lauka.

JOANNITES.

„ 3. JOANNITES cf. cymbiformis (Wulfen), p. 101. Chambered cast. From the grey Traumatocrinus limestone of Rimkin Paiar.

„ 4. Plan of the sutures of a specimen from the same locality.

ARCESTES.

ARCESTES LEONARDI, E. v. Mojs., p. 98.

„ 5. Specimen, with the body-chamber and the test. From the Halorites Limestone of the Bambanag Section.

„ 6. Specimen, with the body-chamber broken at the aperture, in order to show the last lip. From the same locality.

„ 7. Chambered form, with the test. From the same locality.

„ 8. Plan of the sutures of a specimen. From the same locality.

„ 10. ARCESTES SUBBICORNIS, E. v. Mojs., p. 99. Specimen with the body-chamber and the test. From the black limestone of Tera Gadh.

DIDYMITES.

„ 9. DIDYMITES AFGHANICUS, E. v. Mojs., p. 44. Chambered form. From the black limestone of the Zhob Valley.

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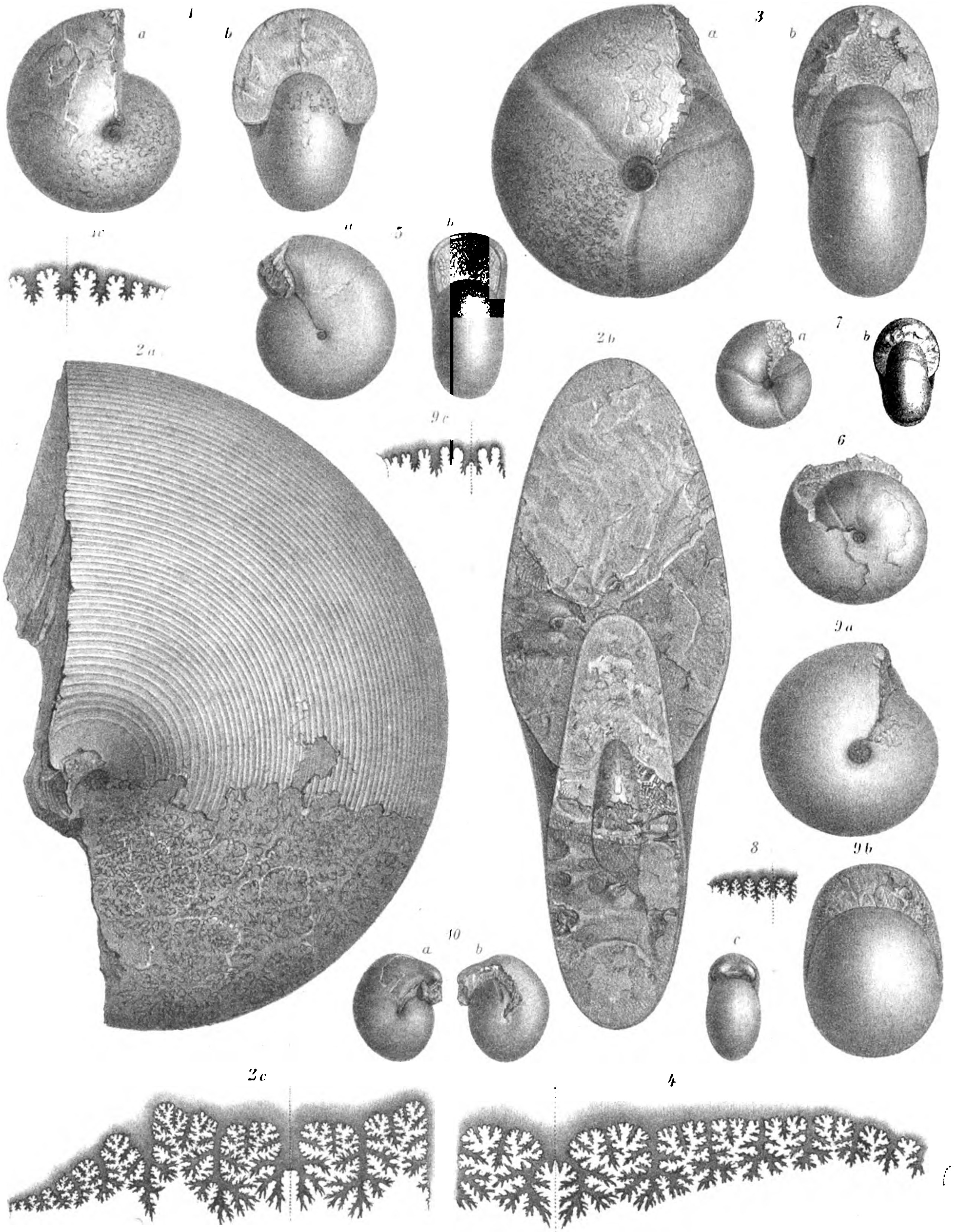

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PLATE XXI.

NAUTILUS.

Fig. 1. **NAUTILUS BAMBANAGENSIS**, E. v. Mojs., p. 122. From a cast, with the body-chamber. From the Halorites Limestone of the Bambanag Section.

„ 2. **NAUTILUS**, f. ind., ex aff. N. mesodici., p. 122. Chambered cast. From the Halorites Limestone of the Bambanag Section.

PLEURONAUTILUS.

„ 3. **PLEURONAUTILUS TIBETICUS**, E. v. Mojs., p. 120. Calcified chambered cast, with some portions of the test. From the lower Daonella beds of the Bambanag Section.

ATRACTITES.

„ 4. **ATRACTITES**, ind., p. 126. Fragment of a phragmocone, with part of the test; *a*, ventral aspect, *b*, posterior septum, seen from below. From the Halorites Limestone of the Bambanag Section.

ORTHOCERAS.

„ 5. **ORTHOCERAS**, f. ind., p. 126. Cast, with the body-chamber. From the Halorites Limestone of the Bambanag Section.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

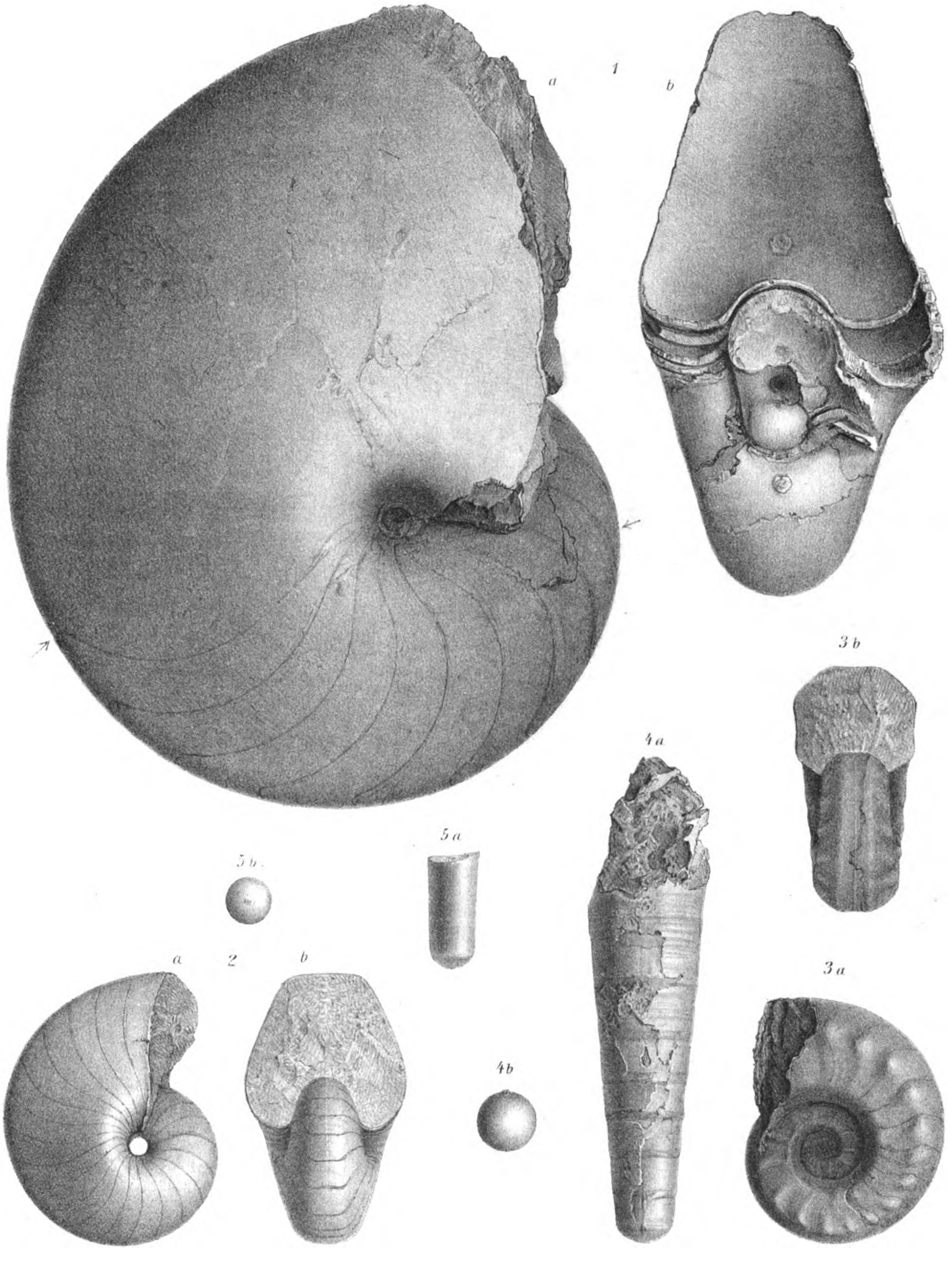

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PLATE XXII.

CLYDONAUTILUS.

Fig. 1. CLYDONAUTILUS GRIESBACHI, E. v. Mojs., p. 123. Chambered cast. From the limestone with Pinacoceras cf. imperator (No. 6) of the Bambanag Section.

CLYDONAUTILUS BIANGULARIS, E. v. Mojs., p. 124.

„ 2. Chambered cast. From the Halorites Limestone of the Bambanag Section.

„ 3. Example of a cast, with the body-chamber and portions of the test. From the same locality.

All the figures are of the natural size, and were drawn directly on the stone without the use of a reflector.

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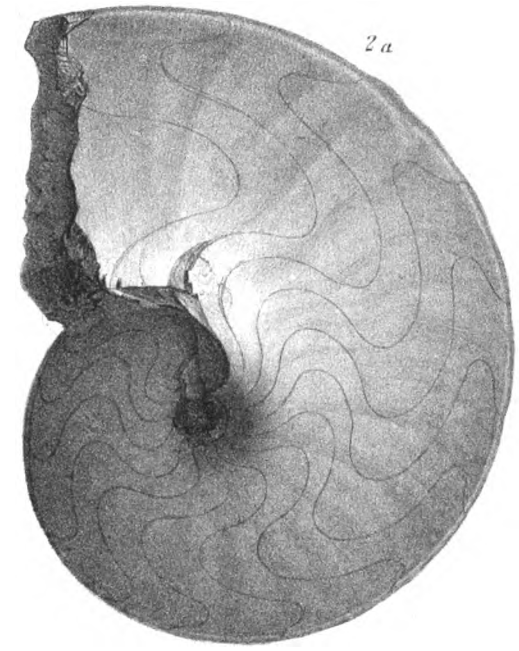

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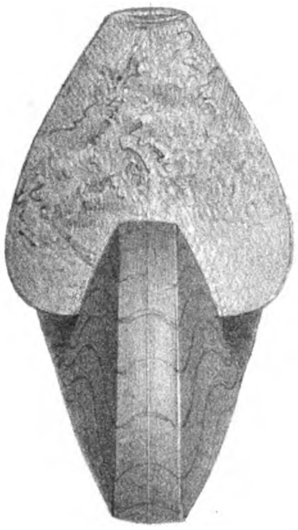

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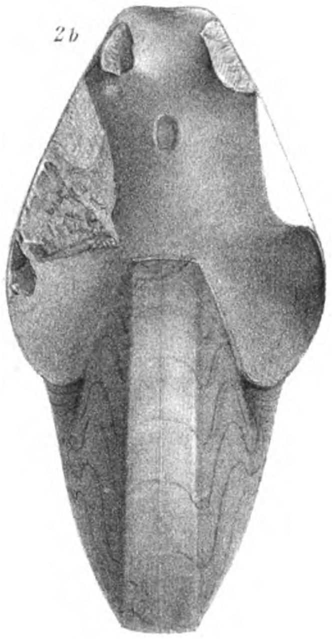

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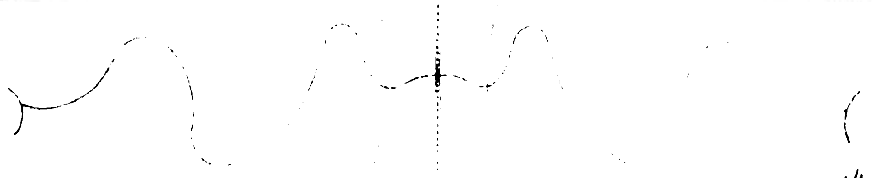

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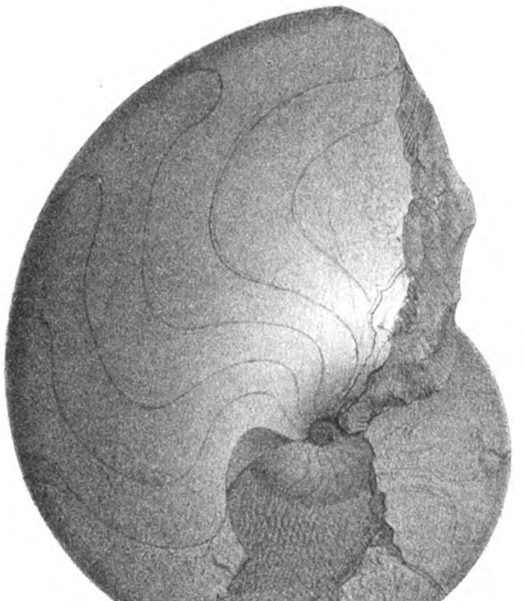

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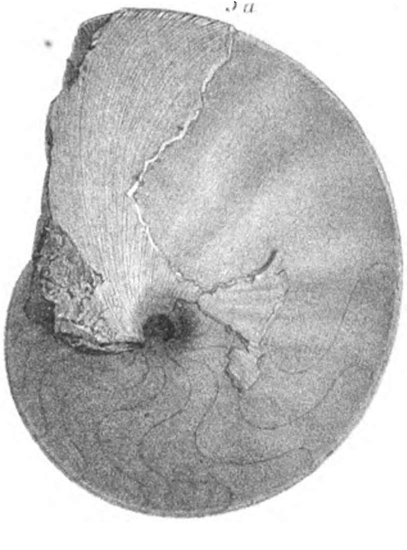

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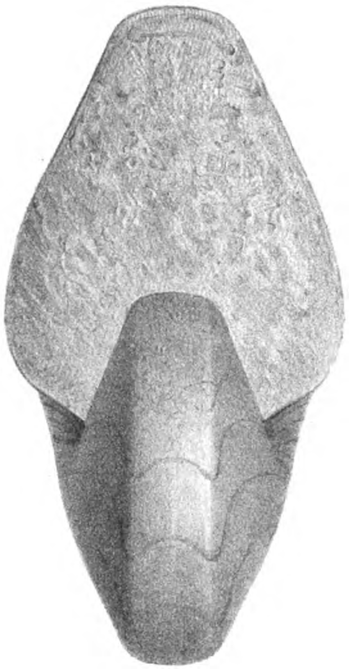

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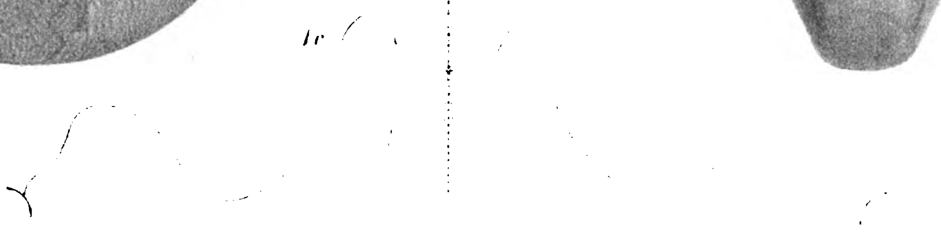

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PUBLISHED BY ORDER OF HIS EXCELLENCY THE GOVERNOR GENERAL OF INDIA IN COUNCIL.

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Vol. III, Part 2.

TRIAS BRACHIOPODA AND LAMELLIBRANCHIATA.

By Dr. ALEXANDER BITTNER,
K. K. Geologische Reichsanstalt, Vienna.

TRANSLATED BY
ARTHUR H. FOORD, PH. D., F.G.S., AND MRS. A. H. FOORD.
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„ (?) Salteriana, Stol. 15
„ semiplecta, Munst. var. *See* R. Griesbachi 12
„ Theobaldiana, Stol. 17
„ (Norella) Tibetica, n. sp. 32
„ cf. trinodosi, Bittn. 14
Spirifer. *See* Spiriferina. . . . . ?
„ Oldhami, Salt. 22
Spiriferina altivaga, Stol. 53
„ Griesbachi, n. sp. 51
„ (Mentzelia) Kœveskalliensis, Suess 21
„ Lilangensis, Stol. 20
„ Shalshalensis, n. sp. 42
„ Spitiensis, Stol. 21
„ Stracheyi, Salt. 18
„ tibetica, Stol. 52
Spirigera Deslongchampsi, Suess. 24
„ Dieneri, n. sp. 54
„ hunica, n. sp. 31
„ (?) Nœtlingii, n. sp. 68
„ Strohmayeri, Suess. 23
„ Stoliczkai, n. sp. 23
Terebratula (Dielasma) Himalayana, n. sp. 25
„ „ aff. Himalayanæ, n. sp. 27
„ (Cœnothyris) cf. vulgaris, Schloth. sp. 28
Waldheimia Stoppanii, Suess. 25

HIMALAYAN FOSSILS.

VOL. III., PART 2.

TRIAS BRACHIOPODA AND LAMELLIBRANCHIATA.

BY

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WITH 12 LITHOGRAPHIC PLATES.

The following descriptions are based upon a portion of those fossils of the trias of the Himálayas which have been entrusted to Prof. E. Suess, of Vienna, for purposes of palæontological investigation, by the Directors of the Geological Survey of India, Messrs. W. King and C. L. Griesbach. With the exception of those fossils belonging to F. Stoliczka's earlier collections, they have all been found by Mr. C. L. Griesbach himself. To these may be added the remnants of Brachiopoda and Lamellibranchiata collected by Dr. C. Diener in the year 1892 in the triassic region of the Himálayas. It was originally intended that the rare Gastropods should also be examined, but when their number had somewhat increased through the collections made by Dr. Diener, especially those from the triassic limestone of Tibet, I thought it advisable to offer them for investigation to our well-known authority, E. Kittl, Curator in the Imperial Museum, Vienna. But at that time the first plate for the present work had already been drawn, and upon it was figured a species of the genus Bellerophon, which must therefore also be treated of in the text. The sign 'etc.' added to the running title of the plates, refers therefore only to this one fossil. The descriptions of the remaining Gastropods by E. Kittl will follow. In accordance with a wish expressed by Mr. C. L. Griesbach, the Director, the descriptions of the species were disposed according to the chronological succession of the formations, and the arrangement of the plates, as far as it was possible, was effected in such a manner that fossils from the same formation were included in the same plate. The descriptions begin with the species belonging to the oldest triassic deposits of the Himálayas. With reference to the divisions of these deposits attention should be drawn to the important work of Mr. C. L. Griesbach, *viz.*, "Geology of the Central Himálayas", in the Memoirs of the Geological Survey of India, Vol. XXIII., 1891, and also to the more recent contributions of Dr. C. Diener, "Ergebnisse einer geologischen Expedition in den Central Himálaya von Tohar, Hundés und Painkhanda," in the Denkschriften der Kais. Akademie der Wissenschaften in Wien, Band LXII., 1895.

I. BRACHIOPODA AND LAMELLIBRANCHIATA FROM THE LOWER TRIAS (BUNTSANDSTEIN, OR WERFEN-SLATE BEDS) OF THE HIMÁLAYAS.

a. *From the Lower or Otoceras Horizon.*

From the lowest fossil-bearing beds of trias of the Himálayas, the so-called Otoceras Beds (according to Dr. C. Diener's more restricted term), Mr. C. L. Griesbach ("Geology of the Central Himálayas," page 146) has already enumerated, besides Bellerophon, sp., the following species of lamellibranchiata :—*Posidonomya angusta*, Hauer, var., *Avicula Venetiana*, Hauer, var., *Gervillia mytiloides*, Schloth., *Modiola triquetra*, Seeb., *Myophoria ovata*, Schaur.

All the specimens mentioned by Griesbach under the above names are before me, and besides these also another series from these beds collected by Diener.

Taking this material as a criterion, the lamellibranchiate fauna of this horizon proves to be poor and wanting in variety, as besides the predominant genus *Posidonomya*, conspicuous by the number, as well as the size, of its species, all the remaining species appear to occur restricted in number and small as individuals. It is interesting to find a Bellerophon associated with these lamellibranchs, and equally so is the isolated occurrence of a brachiopod of the family of the Rhynchonellidæ, which latter is yet unknown in such low triassic deposits of the Alpine trias of Europe.

PSEUDOMONOTIS GRIESBACHI, nov. spec., Pl. I., Figs. 1—4.

By far the most frequent and remarkable species among the bivalves of this fauna belongs to that group of the Aviculidæ which plays so important a part in the Alpine Werfen slates, and which was united at first to Posidonomya, later to Avicula, and is now customarily placed in Pseudomonotis, on the authority of F. Teller. *Pseudomonotis* (*Posidonomya*) *Clarai*, Buch, sp., is taken as the type of this group of the lower triassic Aviculidæ.

The present Indian form is remarkably large, very unsymmetrical, more or less oblique, with very unequal valves, of which the left one is considerably inflated and the right one almost flat and lid-like.

The inflation of the left valve is by far the strongest in the region of the umbo, while farther from the latter it becomes much more flat. The umbo itself projects considerably beyond the hinge-line of this valve; the hinge-line is long and straight, and divided into two very unequal parts owing to the position of the umbo, which is pushed far towards the anterior end. The anterior part of the hinge-line forms about a quarter of its total length. This anterior portion of the hinge-line of the inflated left valve is not generally formed into a well-developed wing or ear, but in well-preserved specimens (*e.g.* enlarged figure, Pl. I., Fig. 1) a slight incurvature in the lines of growth at its margin can be perceived.

The Indian form does not possess a true incurvature in this region, such as that which R. Lepsius (Südwesttirol, Tab. I, Fig. 1*b*) indicates in the anterior ear of the left valve of a very closely related species from the Alpine Werfen slates, but I doubt whether this can be attributed to the Alpine form, and I am very much inclined to refer the figure mentioned above to the inner side of a right valve, supposing that the drawing is really true to nature, and that the incurvature is not accidental. Whilst Lepsius, as I presume, thus wrongly attributes a byssal sinus also to the left valve of one of these forms, A. Tommasi (Palæontographia Italica, Vol. I., 1895), has lately come to a diametrically opposite conclusion, for he denies the existence of a byssal ear also for the right valve of such a form (cf. Verhandl. der geol. R. Anstalt, 1897, p. 105.)

The right or 'lid-valve' of these lower triassic species possesses in fact an unusually distinct, very deep byssal sinus, which almost separates the feebly developed anterior ear from the rest of the shell. This can also be said of the Asiatic form to be described in these pages. The umbo of the right valve hardly projects above the straight hinge-line, the umbonal region is not at all elevated in front, but up to a third of its height it is either quite flat, or even a little depressed; farther below, however, this valve appears also slightly convex. The ear of the anterior side (byssal ear) possesses a steeply sloping outer margin, on which the crowded lamellar lines of growth overlap; the incurvature of all the lines of growth into the byssal sinus is very distinctly perceptible.

The surface of both valves appears almost smooth, as the striæ of growth are reduced to a merely inconspicuous concentric sculpture, while a true radial sculpture scarcely exists. The striation of growth is strongest near the hinge-line, appears generally to be a little more distinctly marked on the right valve than on the left, and rarely assumes the character of very indistinct ridges (Fig. 1.) ; and it occurs mostly only in the form of slightly elevated, irregularly distributed, concentric lines. Such regular fine concentric ornamentation as characterises the Alpine form designated by W. Salomon as *Pseudomonotis ovata*, Schaur., spec., seems to occur only quite exceptionally in the Asiatic one. In the Asiatic form the radial ornamentation, which at the utmost consists of quite faint radiations only observable when the light falls suitably upon them, is still more indistinct than the concentric ornamentation. The angle which the hinge-line makes with the vertical axis varies a little, that is, there are examples of this species of which some are shaped more obliquely (Pl. I, Figs. 2, 3,) and others less so (Figs. 1—4).

The Pseudomonotis here described from the lowest triassic deposits of the Himálayas is very closely related to certain Alpine forms. Among these the most remote relationship is with *Pseudomonotis Clarai*, whose sculpture, well-marked in typical specimens, and consisting of concentric ridges and radial ribs, is almost entirely absent in the present species. But the form described by F. von Hauer as *Pseudomonotis* (*Posidonomya*) *aurita*, sp., which other authors would unite with *Ps. Clarai*, shows a very perceptible dying out of that sculpture, and becomes thus much more like our form. This is still more applicable to those specimens for which Salomon has again employed the old name *Ps. ovata*, Schaur., and in which the radial sculpture is almost or completely wanting. If one considers with Salomon the figures 6, 7 and 9, of F. von Hauer's *Ps. aurita*, sp., as types, and places these in *Ps. Clarai*, or only near this species, the difference between the Asiatic form and *Ps. Clarai* can be estimated to a certain extent by the almost complete absence of a true radial ribbing in the former. Notwithstanding their great resemblance the Asiatic form could then also be distinguished from Salomon's Alpine *Ps. ovata* by the faintness and irregularity of its concentric sculpture. If it was desired to agree with Salomon in uniting the present species with *Ps. ovata*, Schaur., which could be effected by making only a slight extension of the species, it would be advisible to test the validity of the name introduced by Salomon, for it cannot be denied that the name is by no means free from objection. The very specimen figured by Schauroth, originally as var. *ovata*, does not agree very well with the newer figure of Salomon's species, and it is not at all certain that both authors understood exactly the same species under this name. Salomon's reference to Schauroth's name seems thus to have no strong justification. A. Tommasi describes apparently identical Alpine forms, such as those given by Salomon, as *Posidonomya Haueri*, and he unites with this species, as a synonym, Salomon's *Pseudomonotis ovata*, Schaur., sp., which he could not have done if he had been convinced that Schauroth's original form was really identical with Salomon's. On the other hand, Tommasi's species is certainly not a Posidonomya, but a Pseudomonotis. The mutual relationship of the species as expressed in their nomenclature becomes more and more confused, so much so that it is already getting very difficult to choose a perfectly suitable name for each of them from among those already in use; unless one unites all of them together under the oldest of these names, *viz.*, "*Pseudomonotis Clarai.*"[1] It will not therefore be possible before a fresh investigation of these forms is made on the basis of ample material, fully to explain their specific relationship, and to regulate their names accordingly. Before this can be effected it seems to me most advisable, as none of the existing specific names is quite applicable to the Indian form, to name it anew, and to designate it, in honour of its discoverer, *Pseudomonotis Griesbachi*. But with reference to its characteristics, it must again be emphasized that its sculpture is very feebly developed, whereby it is distinguished, not only very markedly from the strongly ornamented

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[1] The name *Posidonomya angusta*, used at the time by Mr. C. L. Griesbach, is to be traced back to older designations in the collection of the k. k. geol. Reichsanstalt, in which the name, occurring through an evident error, according to Catullo. (cf. F. V. Hauer, l. c., p. 12) had by chance escaped correction. This name cannot therefore be employed.

Ps. Clarai and its radially ribbed allied forms, but also, though in a somewhat less degree, from the forms designated at present as *Pseudomonotis ovata*, Schaur. (Sal.), or *Posidonomya Haueri*, Tom. Single individuals of the Asiatic form may, however, be very closely related to the last-named European forms. The smoothness of the surface of the shell, *i.e.*, the vanishing of the sculpture, is the most important feature of the Asiatic form, in contrast to its Alpine congeners, of which not one can be regarded with so much right as really smooth-shelled as *Pseudomonotis Griesbachi*. The latter is the most abundant and most characteristic species among the few bivalves known as yet at the base of the triassic deposits of the Himálayas, and especially in the lowest division, the so-called Otoceras beds. In the limestones of these beds, which are mostly dark, it is often preserved with its shell which is glossy black and shines like velvet.

The localities at present known of *Pseudomonotis Griesbachi* are:—The Shalshal Cliff, near Rimkin-Paiar, where the species was first discovered by Mr. C. L. Griesbach, the Director of the Geological Survey of India, and later also collected by Dr. C. Diener, and from which place the specimens figured were derived.

Some fragments, which certainly belong to this species, come from the neighbourhood of Kiunglung, South-West of the Niti Pass.

A small number, mostly fragments, of particularly large specimens are from the hills to the south of Kuling in Spiti.

Some of these specimens possess the remarkably fine and regularly concentric striation that occurs in *Pseudomonotis ovata*, Schaur. (Salomon). They have also been found by Griesbach. Their matrix only varies a little from that in which *Ps. Griesbachi* occurs in the Shalshal Cliff. It is therefore possible that *Ps. Griesbachi*, and a species perhaps not separable from *Ps. ovata*, Schaur. (Salomon), occur associated in the Himálayas. This association would be of great interest, not only for the definite establishment of the relationship, already very close, between them, but also for stratigraphical comparison.

PSEUDOMONOTIS PAINKHANDANA, nov. spec., Pl. I., Fig. 5.

Associated with the more abundant form described above under the name of *Pseudomonotis Griesbachi*, there occurs an isolated form of Pseudomonotis, which is much smaller, less oblique, vertically elongated, and cannot be specifically united, without reservation, to the former. Small specimens of the inflated left valve of *Pseudomonotis Griesbachi*, when compared with equal-sized specimens of the second species, taken at the same height, give a ratio of length (breadth) of about 4 : 3, which, as the illustration shows, implies very differently-shaped outlines. I should have liked to call this form *Ps. angusta*, if this name had not already been employed for *Ps. Griesbachi*. The left valve, the only one at present known, is highly inflated, recalling a little in its form Lingula, or certain species of Discina, but of course inequilateral, with a hinge-line very short anteriorly and about three times as long posteriorly. The umbo is strongly inflated and projects above the straight hinge-line.

The ornamentation of the surface of the shell is the same as in *Ps. Griesbachi*, to which it is, doubtless, very closely related, differing only from the latter in its narrow shape.

Among its Alpine congeners such a remarkably narrow form is, so far as I know, yet unknown, and for this reason it deserves to be distinguished by a special name.

Locality.—In the dark Otoceras beds of the lowest trias in the section of the Shalshal Cliff, near Rimkin-Paiar.

AVICULA, AFF. VENETIANÆ, Hauer, Pl. I, Fig. 8.

Besides the typical Pseudomonotis species of the Clarai Group there is in the Alpine Buntsandstein formations or Werfen slates a second Avicula type, widely distributed, which is represented by Aviculopecten-like forms, such as *Avicula Venetiana*, Hauer, auct. (general name), *Pecten Fuchsi*, Hauer, *Avicula striatoplicata*, Hauer, *Avicula inæquicostata*, Benecke, and others, forms whose mutual relations as species are only in part very insufficiently established. This Avicula type occurs also in the Otoceras beds of the Himálayas, from which Griesbach himself has already cited *Avicula Venetiana*, var.

In most of the forms belonging to this species only the left valve is as yet known, and this is also the case with the Asiatic form of this group under description. Its left valve is much inflated and only slightly oblique, with an umbo only a little pushed out of the median line. The hinge-line is straight, the umbo projecting above it, the former having on each side an ear (or wing), of which the posterior one is broader than the anterior, but appears rather indistinctly differentiated from the rest of the shell, while the narrower anterior ear is separated from the latter by a well-marked radial furrow. This radial furrow corresponds to a slight emargination between the anterior ear and the rest of the shell at the anterior margin, in which the lines of growth bend distinctly arch-like inwards. Nothing like this is to be noticed near the posterior ear.

The entire surface of the shell, including the two ears, is ornamented with numerous radial ribs, the greater number of which originate near the umbo, while farther out others insert themselves, so that finally three different degrees of strength or systems of such ribs occur, whose alternation is by no means distinguished by special regularity. The sides of the shell and the ears are more evenly and finally ribbed than the central area of the shell. Through the lines of growth crossing this area the stronger ribs become here and there rough, especially towards the lower margin. The shell itself is tolerably thick at the umbo. The cast possesses less distinctly marked, smooth ribs.

Among the related Alpine species, of which there are sufficient representatives, *Avicula inæquivalvis*, Benecke, the originals of which, thanks to the kindness of Professor Benecke, I am in a position to compare, might be regarded as the nearest to the present species. But the southern Alpine species is already dichotomously and more distinctly ribbed nearer to the umbo, and moreover possesses in the left valve a more strongly defined anterior ear, which is traversed in the centre by a radial swelling. The posterior ear might have been just as wide and as little defined as it is in the Indian species, as it can be distinctly recognised in Benecke's original specimen, Fig. 5. *Avicula Venetiana*, Hauer, known for a longer time, is unfortunately represented by such badly preserved forms among Hauer's original specimens that an exact comparison of them with related forms appears almost impossible. It may, therefore, be easily understood that this species has gradually become a general type, and that different authors have in the course of time indicated and recorded various forms as *Avicula Venetiana*, Hauer. The original *Avicula Venetiana*, Hauer, is, in any case, a form closely related to the species described above and the one referred to as Benecke's. In the less sharply defined, dichotomous ribbing, the original of Hauer's *Venetiana* (Fig. 3) stands, it would seem, even nearer the Indian form than Benecke's species. This original species of Hauer's indicates also that the anterior wing is ear-like, and the front margin correspondingly emarginate, while the posterior wing almost merges into the rest of the shell. Hauer's illustration, it is true, wrongly shows a distinctly defined posterior ear. Still more markedly schematic are Hauer's illustrations, Figs. 1 and 2, with respect to the ribbing. I consider all the specimens figured by Hauer, including Fig. 2*a*, to be left valves. The one ear of Fig. 2*a* (the lower one in the drawing) is not present in the original. I am disposed to think that *Avicula Venetiana* also possessed a flat, right or lid valve, which seems to be very seldom found. If this should be regarded as strange and improbable, the recognised fact may be pointed out that in the Werfen slates whole layers are found with weathered specimens of *Pseudomonotis Clarai*, all of which turn in the same manner the inflated left valve out wards, whilst the small flat, right valve only very seldom appears in such layers. These forms, which are mostly in colonies, appear to have been buried in the rock as they lived, attached to one another by the byssus. In this manner the flat right valve was probably still further pressed into the larger opposite valve, and thus generally escapes observation. The same may also be said of related Aviculidæ, that is, of those with similiarly unequal valves. Who has not been struck with the rare occurrence of the right valve of the Rhætic *Avicula contorta*, Portl. ? Perhaps still more rare is the right valve of *Cassianella decussata*, occurring in hundreds of specimens in the St. Cassian beds and the case is exactly the same with the rest of the species of Cassianella.

From a lower triassic deposit of the island of Russkij in the Amoor region, closely related to the Werfen slates and the Otoceras beds, I have before me some slabs collected by Iwânow, which are entirely covered with confusedly scattered inflated valves of an *Avicula*, ex. aff. *Venetiana*, Hauer, which is likewise closely related to *Avicula inaequicostata*, Ben., putting aside its somewhat finer and closer ribbing. Among these numerous inflated valves, there is only one single specimen of a flat right valve, with well-developed byssal ear, of distinctly marked Aviculid type, and provided with crowded ribbing which does not differ essentially from the ribbing of the other inflated valves. I cannot regard this single valve as anything more than the right valve, unknown until now, of an Avicula of the type of

Avicula Venetiana, that is, as the right valve of an inflated form occurring associated with it. A similar case will be mentioned further on in *Pseudomonotis himaica*. I find also that Benecke is inclined to suppose that the right valve of his *Avicula inæquivalvis* may have been flat, or less inflated than the left one.

Locality.—Collected in the section of the Shalshal Cliff by Messrs. Griesbach and Diener. Griesbach's older specimens bear the following note :—"Three miles south of Rimkin-Paiar, East slope of Kurguthidar, No. 2." Among the specimens brought home by Diener there is one associated with *Pseudomonotis Griesbachi*, both imbedded in the same fragment of rock.

GERVILLIA (?), spec. indet., Pl. I., Figs. 6, 7.

A rather poor and small Gervillia (?) of a somewhat variable outline, which does not appear to be so closely related to any of the known triassic species as to the permian *Gervillia* (*Bakewellia*) *antiqua*, Münst., as it is figured, for example, in King, Pl. XIV., Figs. 31, 33. It is a stumpy form with a strongly inflated left valve and a very flat right one. Among triassic species it has the greatest resemblance to *Gervillia costata* and *G. subcostata* (Credner, Zeitschr. der Deutsch. geol. Gesell., 1851, Tab. VI. Figs. 3, 4). But as even the generic position of the Asiatic form cannot be completely verified it would be useless to carry the comparison further.

Locality.—It appears to be not very rare in the thinly-bedded strata of the Otoceras beds in the Shalshal section near Rimkin-Paiar, associated with *Pseudomonotis Griesbachi* (the specimens collected by Griesbach are labelled with the following locality :—"Three miles south of Rimkin-Paiar, east slope of Kurguthidar").

MYOPHORIA (?) spec. indet., Pl. I., Figs. 9, 10.

These fossils—as is the case with the Gervillia (?) mentioned above—have somewhat greater similiarity with certain permian species of Schizodus than with the forms of the lower triassic group of *Myophoria ovata*, which are so extensively distributed in the Alpine Werfen Slates. Unfortunately, the scarcity of the specimens does not allow of the exposure of the hinge, so a more minute investigation into their relationship is impracticable.

In their shape those Alpine forms which are named "Tapes subundata, Schaur.," from Recoaro, seem to be the most closely related ; but they are considerably longer (wider) than the Indian form.

Locality.—At the Shalshal Cliff, near Rimkin-Paiar (Kurguthidar, east slope) very sparingly, with *Pseudomonotis Griesbachi*, and the above-mentioned Gervillia. The same form seems also to occur near Kiunglung in the vicinity of the Niti Pass.

NUCULA (?) spec. Pl. I., Fig. 11.

A form, quite uncertain as to its genus and which is therefore only mentioned here as Nucula with a query, because of its somewhat recalling by its shape certain

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species of Nucula. As it is impossible to expose the hinge in the single specimen available, no further comparison can be entered into.

Locality.—In the Otoceras beds with *Pseudomonotis Griesbachi* near Rimkin-Paiar.

Remarks.—In the beginning of this memoir all lamellibranchs referred to by Griesbach (see ante, p. 2.) from the Otoceras beds (his "lower beds") have been enumerated, with the exception of his *Modiola triquetra,* Seeb., the determination of which is based upon a very badly-preserved fossil, which is therefore better left unnoticed. A brachiopod and a Bellerophon (cf. Introduction, p. 2.) from the same horizon will be described.

RHYNCHONELLA (NORELLA) PROCREATRIX, nov. sp., Pl. I., Fig. 12.

This Rhynchonella, the oldest among the "reversed" species of Rhynchonella (Norella, m., Abhandlung der k. k. geol. Reichsanst. XIV., p. 315) yet known, is a small slightly inflated form, of which young forms of about 4—5 mm. in length are still quite smooth, without ribs, and scarcely possess any indication of a sinus on the *small* valve, while in larger specimens, of above 5 mm. in length, a slight undulation of the front, besides a broad and shallow sinus in the small valve, are developed. The number of the little folds amounts to nine, of which the three middle ones occupy the tongue-like depression of the front of the shell. The test is fibrous, the beak is well-formed and Rhynchonella-like, with dental plates; a median septum appears to be wanting in the small valve.

The species is distinguished from all species of Norella hitherto described, including the ribbed *Norella Rosaliæ,* Salomon, by its broad and flat form.

In the later triassic deposits of the Himálayas related forms seem to be widely distributed. The species itself is of considerable interest as one of the oldest triassic species of Brachiopoda, for it is known that the Alpine Werfen Slates have yielded so far only a few hingeless brachiopods of the genera Lingula and Discina.

Locality.—In the Otoceras beds with *Pseudomonotis Griesbachi,* in isolated specimens, north-west of Kiunglung, south-west of the Niti Pass. Judging from an impression in the rock this species may also occur in the corresponding horizon of the Shalshal Section, near Rimkin-Paiar.

BELLEROPHON CF. VACEKI, nov. sp., Pl. I., Figs. 15 (13, 14).

The first specimens of Bellerophon of the Alpine trias were, as far as I know, discovered by Mr. M. Vacek, and in very low horizons of the Werfen Slates on each side of the Etsch, south of Botzen, on the Mendelstrasse, and near Montan (Verhandl. der k. k. geol. Reichsanst., 1882, p. 44, also 1894, p. 435). Specimens of Bellerophon were found later in a horizon very nearly agreeing, judging by the matrix, with that of the Werfen Slates, by Mr. G. von Bukowski, in the Spizza region of southern Dalmatia; they belong, however, to a species different from the specimens from southern Tyrol (Verhandl. der k. k. geol. Reichsanst 1895, p. 134).

Mr. Griesbach reported already in the year 1891 (Vol. XXIII., of the Memoirs of the Geological Survey of India, p. 146), the occurrence of species of Bellerophon in his lower triassic Otoceras beds, and since then they have also been known from a similar horizon in the region of the Amur in Eastern Asia, so that they may now be regarded as widely-spread, though rare, palæozoic stragglers in the fauna of the lowest beds of the trias.

The species of Bellerophon of the lower Werfen Slates of the valley of the Etsch and those of the Otoceras beds of the Himálayas seem to be specifically identical, or, in any case, so closely related to one another that, considering their state of preservation, they cannot be specifically separated with certainty.

They are small smooth strongly-inflated symmetrical shells, with rather deep median emargination, a narrow umbilicus closed by a callus, and faintly-marked striæ of growth. The only difference, though a very insignificant one, that I observed in the Asiatic form, as compared with the European, consists in the presence of a slight spiral depression which surrounds the umbilicus and sometimes forms a faint keel around it. I therefore designate the Asiatic form as *Bellerophon* cf. *Vaceki*, and figure two forms of the Alpine species, hitherto undescribed, for comparison with it.

Locality.—In the horizon of the Otoceras beds of the Shalshal Section, near Rimkin-Paiar, containing *Pseudomonotis Griesbachi*, very isolated. More abundant and in larger forms, as it seems, in the same horizon, north-west of Kiunglung in the vicinity of the Niti Pass. Found by Griesbach in both localities.

b. From the Upper or Subrobustus-Horizon.

The upper part of Griesbach's original Otoceras beds has recently been distinguished by Dr. C. Diener as the Subrobustus-Horizon. Besides cephalopoda only a few lamellibranchs have as yet been found. They are as follow :—

PSEUDOMONOTIS (? AVICULA) HIMAICA, nov. sp., Pl. I., Figs. 16—21.

A very inequilateral and inequivalved shell, therefore very oblique, with a ribbed surface. The left valve is greatly inflated and possesses a remarkably long straight hinge-line, and a beak strongly inclined forward and projecting above the hinge-margin. The posterior hinge-margin seems to be not at all marked off from the rest of the shell, while the anterior is of an incompletely ear- or wing-like form. There is scarcely any indication of an emargination on the anterior margin, or of curvature in the lines of growth in the place below that part which is to be regarded as the anterior ear.

The right valve is very slightly inflated, nearly flat; its beak does not project beyond the hinge-margin; anteriorly the latter is developed into the form of a byssal ear, and almost entirely marked off from the rest of the shell by the deep notch.

With the exception of the almost smooth beak, both valves are ornamented with numerous, nearly equally strong, slightly raised, blunt, and proportionally broad ribs, which reach the hinge-margin on both sides. In the middle of the shell the ribs widen out here and there at irregular distances, and in some places take between them one or several much finer ribs, or include between them only faintly impressed, longitudinally-furrowed, flat spaces. A regular alternation of ribs, differing in strength, does not take place. The ribs are here and there a little bent in their course, and sometimes also pushed out of it by stronger interruptions caused by the lines of growth. Extremely faint, close-set, and regular striæ of growth cross the ribs. In respect to their ornamentation there is no essential difference between the two valves. The byssal ear may be without ribs.

Whether it is better to place this species in Pseudomonotis or in Avicula, must be left undiscussed. Certain species of Avicula described by F. Teller from the triassic deposits of northern Siberia resemble this species, but they are less oblique and inequilateral. *Monotis ovalis*, Whiteaves (Contributions to Canadian Palæontology, Vol. I., Part II., 1889, p. 133, Pl. XVII., Fig. 4) from the trias of British Columbia, seems really to be very much like our species, but according to the description its hinge-margin appears to be shorter, its beak not lying so far forward, and the ribs are indicated as particularly broad, being in the median pallial margin even broader than the spaces between them, which is not the case with our species. At any rate *Monotis ovalis*, of which only the left valve is known, may be the nearest to our species, supposing, of course, that that species is *not* a Monotis.

Locality.—Collected by Dr. Diener in the Shalshal section, near Rimkin-Paiar, in a light gray limestone which, from its horizon, belongs to the beds indicated by Dr. Diener as the Subrobustus beds succeeding the true Octoceras beds containing *Pseudomonotis Griesbachi.*

As a great number of left valves in different stages of growth (Figs. 16-20), and one right valve (Fig 21), could be got out of the few fragments of rock obtained, the species seem to be very abundant in these beds. Associated with it I only found a second bivalve, the description of which is here subjoined.

PSEUDOMONOTIS DECIDENS, nov. sp. Pl. I., Figs. 22—24.

This Pseudomonotis may be regarded as a depauperated, irregularly-formed descendant of the older *Pseudomonotis Griesbachi* described above. Two of the three specimens, all left valves, possess an irregularly formed beak (Figs. 22, 24), which irregularity occurs in differing degrees among them, and in such a manner as to make it difficult to trace it to a distortion produced later in the rocks. More regular specimens (Fig. 23) resemble very closely *Pseudomonotis Griesbachi*, but they remain, however, narrower, and are, on the other hand, more oblique than the form described above as *Pseudomonotis Painkhandana* associated with *Pseudomonotis Griesbachi.*

Locality.—Occurring with *Pseudomonotis* (? *Avicula*) *himaica* already described, in light gray limestone of the Subrobustus beds of the Shalshal section near Rimkin-Paiar.

11.—BRACHIOPODA AND LAMELLIBRANCHIATA FROM THE MIDDLE TRIAS (MUSCHELKALK) OF THE HIMÁLAYAS.

The Muschelkalk has yielded a larger number of species than the lower trias of the Himálayas. It is well known that of late the trias has often been divided only into lower and upper, and the Muschelkalk reckoned to be in the lower. If, however, one starts from the old and original three-fold division of this formation and thus admits the existence of a middle trias, it is natural for the Muschelkalk to stand for the latter. The more so if one gives a considerable upward range to the Alpine Muschelkalk as is now done. It is only in this sense that we here speak of the middle trias.

(a). *Brachiopoda and Lamellibranchiata from the principal complex of the Muschelkalk of the Himálayas, including the beds with* Rhynchonella Griesbachi, *m.* (*Rh. semiplecta, Münst., var., according to Griesbach*), *and with* SPIRIFERINA STRACHEYI, Salter.

In this part will be described not only those species which originate in the principal complex of the Muschelkalk of the Himálayas, but especially also those numerous species which have been found in those beds in which brachiopoda predominate. Griesbach has already distinguished them as a special horizon (*Rhynchonella semiplecta*-horizon), at the base of this complex, and Diener has recently assigned them to the horizon of *Sibirites Prahlada*, whose characteristic fossil, however, according to the discoveries yet made, is *Spiriferina Stracheyi*, Salter. The question as to whether the beds with *Rhynchonella Griesbachi* are really exactly of the same age as those containing *Spiriferina Stracheyi* will be discussed later on. The longest known brachiopods of the trias of the Himálayas, already partly described by Salter and Blanford, as well as by Stoliczka, belong, as will be shown, to the beds with *Spiriferina Stracheyi*. They seem to form a persistent, widely-distributed assemblage of species in those deposits.

RHYNCHONELLA GRIESBACHI, Pl. 11., Figs. 1—7.

Rhynchonella semiplecta, Münst,, var., according to Griesbach, " Geology of the Central Himálayas," Mem. Geol. Surv. of India, Vol. XXIII., pp. 70, 143.

Rhynchonella Griesbachi, nov, sp. (Bittn.), according to C. Diener, Ergebnisse einer geolog. Expedition in d. Central Himálaya in Denkschr. d. kais. Akad. d. Wissensch. LXII. Wien, 1895, p. 571 (39).

It has already been remarked (by Diener) in the paper above-cited that this " Rhynchonella semiplecta, *var.*" has nothing in common with the St. Cassian species of that name, but that this name refers to a species of the Alpine Muschelkalk which was formerly very often indicated, especially by Stur, as *Rhynchonella semiplecta*, cf. This I have named *Rhynchonella trinodosi* (Abhandl. der k. k. geol. Reichsanst., XIV, p. 13), with which species it certainly has some resemblance, without, however, being identical with it. As Mr. C. L. Griesbach was the first to refer to this species, I have done myself the pleasure of naming it in honour of him.

Rhynchonella Griesbachi, of which there are nine specimens from the locality, three miles south of Rimkin-Pair, where Griesbach first found it, is rather a variable form. Its test is almost smooth, only provided at the front with slight folds; the large valve projects in front in the shape of a rather broad, well-developed tongue-like lobe without, however, at the same time forming a distinctly marked sinus. Consequently the small valve is also very moderately inflated in the median area. The line of junction of the valves (commissure) at the lobe has from two to four folds; in the shallow sinus of the large valve, however, there are from one to three little folds which here, as well as on the inflated part of the small valve, are very slightly indicated and are very short. They are arranged mostly symmetrically, rarely unsymmetrically, but never, even approximately, so strong as in *Rhynchonella trinodosi,* or so long as in the species from the Olenek delta in Siberia, which is closely related to *Rhynchonella trinodosi,* and is described and figured in Mém. de l'Acad. impér. des Sciences de St. Pétersbourg, VII. Série, Tom. XXXIII, 1888, p. 139, Tab. XX. The Virginian *Rhynchonella Halli,* Gabb (Journ. Acad. Nat. Sci. Philadelphia, IV., 1858-66, p. 308, tab. 48, fig. 29) stands very near to *Rhynchonella trinodosi.*

Besides the little folds on the frontal lobe there are a few similar folds on each side of the shell. The greater number of the specimens possess an almost circular contour, and only a few (e.g. Fig. 5.) prove to be somewhat elongated. A very strong septum, almost attaining half the length of the shell, developes itself in the median line of the small valve, and under the beak of the large valve there are strong dental plates, arranged almost parallel to one another and of considerable length. The septum of the small valve projects far into the interior of the valve (Fig. 7).

The European *Rhynchonella trinodosi* has not nearly such long dental plates in the large valve, and the median septum of the small valve is also in this species much less strongly developed and is shorter and thinner.

Locality of Rhynchonella Griesbachi.—In Bed 121 of the Shalshal section worked out by Griesbach, three miles south of Rimkin-Paiar, in the "Earthy Limestone," which, according to Griesbach, forms the base of the Muschelkalk series. This section of the Shalshal Cliffs, studied by Griesbach, is, according to Dr. C. Diener, l. c., p. 543 (11), not locally identical with the section of the Shalshal Cliffs, which Diener himself, in company with Griesbach, had the opportunity to investigate later. I lay stress upon this, because the brachiopoda, which I obtained from different localities, presumably of the horizon of *Rhynchonella Griesbachi,* can by no means of themselves permit of the conclusion that they belong to one and the same horizon. It seems, moreover, very remarkable that in the material originally collected by Griesbach, besides the more abundant *Rhynchonella Griesbachi,* there occur, but more rarely, only two brachiopods which are entirely wanting in the material collected by Dr. Diener; while on the other hand, the large species of Spiriferina, Spirigera and Terebratula, which predominate in Diener's collection, must be wanting in Griesbech's original locality, as they would surely not have been overlooked by Griesbach, beside the three insignificant species which he had collected there. The typical form in the brachiopod fauna of his horizon with *Sibirites Prahlada*, exhaustively studied by Diener, which horizon he regards as equivalent to Griesbach's Rhynchonella beds at the base of the Muschelkalk, is by no means *Rhynchonella Griesbachi*, but *Spiriferina Stracheyi*, Salter. On the other hand, *Rhynchonella Griesbachi* has not yet been found to occur in those beds, worked out by Diener, with *Spiriferina Stracheyi*, as it appears, but seems to be represented in them by another and much rarer species. This species will immediately be described under the name of *Rhynchonella Dieneri.*

RHYNCHONELLA DIENERI, nov. sp., Pl. II., Figs. 8, 9.

Only two specimens of it are known; it is considerably broader and shallower than *Rhynchonella Griesbachi*, possesses a more strongly marked sinus in the large, a correspondingly stronger inflation in the small, valve, as well as a higher, that is, more prominent frontal tongue or lobe. The ribbing is, as in *Rhynchonella Griesbachi*, confined to the frontal region, and is similarly indistinctly developed. Both specimens have three small folds in the sinus of the large valve and a few small folds on the contiguous lateral margins. The septum of the small valve appears to be considerably less strongly developed than in *R. Griesbachi.* In its total habit *R. Dieneri* reminds one far more of the true *R. semiplecta* of St. Cassian, and also of *R. productifrons*, m., from the 'marbles' of the Schreyeralm (Muschelkalk), than of *R. Griesbachi. R. productifrons* is however provided with numerous little folds on the lateral margin; while *R. projectifrons*, m., from the Schreyeralm, is almost completely smooth. *R. semiplecta*, Münst., of the St. Cassian beds, possesses a narrower frontal lobe in proportion to its total breadth, which lobe is, moreover, generally quite, or almost quite without folds. Still more widely different is the small St. Cassian *R. semicostata*, Münst., especially in its more strong projecting large valve, which is provided with a very slightly developed sinus.

Locality.—Two specimens collected by Diener on the 27th August, 1892, in the section of the Shalshal Cliffs, near Rimkin-Paiar, in the horizon with *Spiriferina Stracheyi.*

Added to these two species of Rhynchonella described above there is yet a third form which is represented only by one specimen, namely,

RHYNCHONELLA CF. TRINODOSI, Bittn., Pl. II., Fig. 10.

Rhynchonella cf. *trinodosi*, according to Diener, l. c., p. 571 (39).

This specimen is so closely related to the Alpine *R. trinodosi* that I would not on this ground separate it from that species. The specimen reaches a size which it only rarely does in the Alpine species; its frontal lobe is proportionally broad and has two folds, which is only exceptionally the case with *Rhynchonella trinodosi* (cf. Abhandal. der k. k. geol. Reichsanst., XIV., tab. XXXII., Figs. 22, 29). The large valve is remarkably strongly inflated, especially in the region of the beak; the septum of the small valve is thin and moderately long. This form could best be united with *R. trinodosi*, var. *latelinguata* from Wengen in South Tyrol (l. c., Fig. 29) which I have differentiated. It comes, in any case, much nearer to the species of the Alpine Muschelkalk just mentioned than to the two Asiatic species already described.

Locality.—South-east of Muth in Spiti, collected by Griesbach. A single loose specimen obtained from a dark coloured limestone.

Very closely related to the Rhynchonella just mentioned is the form already described by F. Stoliczka.

RHYNCHONELLA MUTABILIS, Stol., Pl. II., Figs. 11, 12, 13.

Rhynchonella mutabilis., Stol., Mem. Geol. Survey of India, Vol. V., p. 40, pl. III., Figs. 5—9.

The dimensions of this species exceed those of the form just mentioned as *Rhynchonella* cf. *trinodosi* so greatly that young forms of *Rhynchonella mutabilis* of the same size as the specimen from Muth, must have been still more completely smooth, that is, without ribs. For the rest, both are so closely related to each other that the specimen from Muth, indicated as *R.* cf. *trinodosi*, could as well be regarded as a small collateral form of *R. mutabilis*, or *Rhynchonella mutabilis* as a gigantic form of the Alpine *R. trinodosi.* It resembles in particular those forms of *Rhynchonella trinodosi* which, having a high frontal lobe, possess two folds in the sinus of the large valve, and therefore a frontal lobe with three folds, as for instance, the specimen which I have figured (l.c., tab. XXXII, Fig. 28). For the greater number of the specimens before me of *R. mutabilis*, that is five out of seven, possess two folds in the sinus, which in *R. trinodosi* occurs only exceptionally and may therefore point to a more intimate connection between the isolated form from Muth and *R. mutabilis*, than between the former and *R. trinodosi.* The folds in *R. mutabilis* are rather long and high, and sharp-edged at the line of junction of the valves ; the septum and dental-plate are inconspicuous and not nearly so strongly developed as in *R. Griesbachi.*

Stoliczka compares his *R. mutabilis* with *R. semiplecta* from St. Cassian, which it, however, only very slightly resembles. From the liassic *R. variabilis*, Schloth., and related forms (as *e.g.*, *R. austriaca*, Suess) it is distinguished by the fact that its ribs do not begin at the beak ; and from all triassic species grouped round *R. trinodosi*, m., by its much greater size. Gabb's *Rhynchonella lingulata* from the trias of California is perhaps closely related to it.

Locality.—According to Stoliczka in the lower (?) trias of Lilang on the Lingti River in Spiti. The rock from which the specimens are derived is a dark limestone. Whether the geological horizon of the species under description is the same as that from which the fauna likewise occurring at Lilang, with *Spiriferina Stracheyi* comes, must be left undecided for the present.

A number of other species of Rhynchonella, which will now be described, belong to types different from those already dealt with.

RHYNCHONELLA (?) SALTERIANA, Stol., Pl. II, Figs. 14, 15.

Rhynchonella Salteriana, Stoliczka, in Mem. Geol. Survey of India, Vol. V., p. 41, pl. III., Fig. 11 (*Sec* Fig. 12).

Under this name Stoliczka unites two forms, one of which, Fig. 12, comes from a light-coloured limestone of uncertain age, of the Austrian Salzkammergut (neighbourhood of Ichl, Hallstatt and Aussee). As it differs widely from the original *Rhynchonella Salteriana*, represented by Fig. 11, it is not necessary to bestow any further attention upon it.

Of *Rhynchonella Salteriana*, Stol., I have, besides Stoliczka's original, Fig. 11, a second specimen which was collected by Dr. Diener in the Shalshal section, near Rimkin-Paiar. Both specimens agree specifically on all points, and prove that one is dealing with a well characterised species, which is very well described by Stoliczka but very inadequately figured.

Rhynchonella Salteriana is a form with an oval outline, with close ribbing, proceeding from the beak. The median part of the frontal area is a little raised, corresponding to a low but distinct median lobe of the small valve. In this median lobe there are seven ribs ; six, therefore, of them belong to the median part of the large valve, which scarcely possesses even the indication of a sinus. In one of the two specimens, one of the two outermost of these middle ribs is doubled, and this duplication agrees in position with a fine intercalated rib in the corresponding furrow of the large valve. Each of the lateral areas of the shell possesses from five to six ribs, which gradually become weaker. The ribs are bluntly rounded. The frontal area is thick, the lateral margins appear flattened, or even somewhat hollowed out and also smooth. The beak of the small valve is broad, flat, and medianly somewhat sunk-in; the beak of the large valve is strongly incurved, and so closely pressed against the beak of the small valve that no kind of opening can be observed in it. Stoliczka's drawing, Fig. 11, is here completed according to its analogy with Fig. 12, an undoubted Rhynchonella, wrongly considered identical, and also the description (p. 41) of this beak is taken from that Rhynchonella, and not from the original of Fig. 11. The latter indeed possesses a beak closely pressed against that of the small valve, one side of which shows a dental plate, exposed by weathering. The second specimen of this species has a perfectly-preserved beak, whose form strongly recalls that of the beak of the palæozoic genera of Rhynchonellidæ, Rhynchotrema, Hall, and Anastrophia, Hall. Unfortunately with the slender material representing this Asiatic species hitherto available it has been impossible to learn anything respecting its internal structure. The shell appears to be fibrous, but I cannot make out that it is punctate.

There is no species known in the Alpine trias which could be compared with *Rhynchonella Salteriana* even in the slightest degree. The form is quite isolated among all the brachiopoda of the trias. It does not appear to me perfectly clear that it is necessarily a Rhynchonella or even a Rhynchonellid, and I cannot help thinking that it may be a 'spire-bearer.' A certain resemblance which it bears to *Spirigera* (?) *Nœtlingii*, nov. sp., to be dealt with later in the Appendix, strengthens me in this suspicion. I have therefore put a query to the generic name of *Rhynchonella Salteriana*.

Locality.—Stoliczka's original comes from Lilang on the Lingti river in Spiti; the second specimen was collected by Diener in the upper Muschelkalk near Rimkin-Paiar. The species, though rare, seems thus to be widely distributed.

Remarks.—*Rhynchonella Salteriana*, Stol., cited by Griesbach in his " Geology of the Central Himálayas," Mem. G. S. I., Vol. XXIII., p. 143, as occurring associated with *Rhynchonella semiplecta*, var. (*R. Griesbachi*, m.), does not belong to this species, but is a new Retzia, which will be described later on as *Retzia himaica*, m.

RHYNCHONELLA THEOBALDIANA, Stol., Pl. V., Fig. 15.

Rhynchonella Theobaldiana, Stoliczka, l. c., p. 41, Pl. III., Fig. 10.

This species, which is represented only by the specimen described by Stoliczka, is in more than one respect doubtful; and it is even a question as to which horizon it comes from.

The specimen is greatly distorted and crushed. The large valve is pushed into the small one near the frontal area, so that a deep sinus with acute lateral margin results, which certainly was not there originally, as the fissures in the shell on each side show. The median part of the small valve is also pushed in near the frontal area, showing here a kind of irregular folding. The beak is medianly cleft, and possesses thick lateral parts, beside a narrow thin-shelled median area at the back. Were the specimen not so compressed, and were it not from its shape a Rhynchonella-beak, one would be inclined to regard the specimen as a greatly crushed form of *Spirigera Stoliczkai*; but on a closer comparison, it does not seem to belong to it, but to be actually a smooth Rhynchonella, whose natural outline one might imagine to have been considerably wider than the compressed specimen shows. A circumstance which argues very strongly in favour of its Rhynchonella nature is the following. Between the median part of the small valve, that is, the broad frontal lobe, and the sides of this valve, runs on each side a sigmoidal furrow-like depression, which is scarcely developed in this manner in smooth species of Spirigera, but is generally present in Rhynchonella. The specimen would have been better left undescribed, but as the name exists, it must, for the present at least, be retained. Perhaps bettter specimens may be found one day, and also information obtained at the same time as to the stratigraphical horizon to which this form belongs.

Locality.—Found, according to Stoliczka, at Muth, in the Pin Valley, in Spiti.

RHYNCHONELLA (NORELLA) KINGI, nov. sp., Pl. II., Fig. 16.

A Norella, *N. procreatrix*, has already been described above (p. 9) from the Otoceras beds of the lower trias. In the horizon of *Rhynchonella Griesbachi*, m., at the base of the Muschelkalk of the Himálayas, a Norella was also found. Judging from the only specimen as yet known, the species is more elongated, narrower, and at the same time thicker, that is, more inflated than *Norella procreatrix*; the sinus of the small valve begins nearer to the beak; for the rest it is very near to that older species, and has, like it, a small number of faint folds at the frontal margin. In the present specimen there are eight or nine of such folds (three of which belong to the frontal sinus), not taking into account the scarcely perceptible sinuosities of the lateral margins further outside. The beak is small and pointed, its edges rather sharp; the lines of junction of the valves are blunt, the front is thick. The shell is distinctly coarsely fibrous. Among the species of Norella of the Alpine trias there is scarcely one species that is particularly closely related to *N. Kingi*. *R. Rosaliæ*, Salomon, from the Marmolata might be taken as the most closely related form; it possesses, however, no lateral folds, but a deeper sinus.

Salter and Blanford in their Palæontology of Niti (Pl. IX, Fig. II) figure a species as *Rhynchonella retrocita*, Suess, which bears a certain resemblance to *Norella Kingi*, but should, according to the illustration, possess much finer and closer marginal folds. Stoliczka has already pointed out that this Niti species cannot be the Alpine *R. retrocita*, Suess, which moreover has since (Abhandl. d. geol. Reichanst., XIV., p. 208) been recognised as a Terebratulid, and has obtained the generic name of Nucleatula.

Locality.—Associated with the more abundant *Rhynchonella Griesbachi*, m., at the base of the Muschelkalk, in the section of the Shalshal Cliffs, three miles south of Rimkin-Paiar, investigated by Griesbach. A single specimen collected by him.

SPIRIFERINA STRACHEYI, Salter, Pl. IV., Figs. 3—14.

Spirifer Stracheyi, Salter, Palæontology of Niti, p. 72, pl. IX., Fig. 13.
Spiriferina Stracheyi, Salter, according to Stoliczka, l. c., p. 38.

Salter was the first to mention this species as coming from the Niti Pass (Rajhoti Pass, according to Stoliczka); Stoliczka himself having known it from Lilang in Spiti. Diener brought home numerous specimens of it from Rimkin-Paiar, where it appears to be one of the most abundant forms in certain deposits of the Muschelkalk of the Shalshal Cliffs section; in any case it is the most remarkable brachiopod of that horizon, which Diener has indicated as the horizon of *Sibirites Prahlada*. Besides these forms from Rimkin-Paiar, I have also before me specimens from Lilang mentioned by Stoliczka, in addition to two specimens from Rajhoti, the first locality of this species, so that an exact comparison and a trustworthy identification of all these discoveries is practicable. *Spiriferina Stracheyi* is rather closely related to the well-known *Spiriferina fragilis* of the European Muschelkalk; in larger forms, however, it acquires a very extraordinary appearance for a mesozoic Spiriferina by the extension of the angles of the hinge-line into wing-like points, which recalls very vividly many palæozoic types of the so-called winged Spiriferidæ. This peculiarity was pointed out by the first describer of the species. The younger specimens of *Spiriferina Stracheyi* (cf. Pl. IV, Figs. 3, 12) already possess a wide hinge-line with very broad and rather high area, so that the greatest breadth of the shell in them occurs already in the hinge-line. Beginning with a certain size a further very pronounced growth in breadth results, whereby the hinge-line is drawn out into pointed wings. At first sight these specimens with the extraordinarily pointed wings might be regarded as a distinct species which also finds expression in my previous observations upon Diener's work (l. c., p. 571 (39)), mentioned in the introduction. More minute examination, however, shows that one has to deal here only with one form, which also agrees with Stoliczka's view, l. c., p. 38. The great variability of forms in the Spiriferidæ is a well-known fact, and for illustration of this one may compare, among others, the work of Gosselet which has recently appeared, *viz.* Étude sur les variations du *Spirifer Verneuili* (Mém. de la Soc. Géol. du Nord, tom. IV., I. Lille, 1894). The median line of the valves in *Spiriferina Stracheyi* is occupied either by a rapidly widening sinus, or a lobe, which is undivided; on each side of it follow in younger forms five to six ribs, which, as growth proceeds, have some less distinct ribs added to them towards the outer side. The wing-like extensions of the sides remain always quite indistinctly ribbed; sometimes distinct folds are seen at their outer margins. The semicircular lateral margin of the younger specimens is modified in the older forms by the development of the wings in a corresponding manner, and acquires with the full development of the points of the wings (Fig. 9) a slight emargination beneath them. The ribbing as a whole is feebly developed. The test, especially near the beak, is considerably thickened, and in the manner characteristic of the Spiriferidæ marked wart-like throughout. The striation of growth is in general weakly developed, and irregular; though in some larger specimens it becomes stronger and closer towards the frontal margin.

The hinge-area of the species is very wide and also of considerable height, almost level, and horizontally striated; the beak only moderately incurved. The inner structure of the beak is tripartite, but in such wise that at the incurved point the three septa are completely fused together by a callosity of the shell (Figs. 6, 7, 13) and only a little farther down do they become free and separated from one another (Figs. 4, 5). The dental plates as well as the median septum reach very far on the outer side of the beak (Fig. 11), and the median septum projects internally up to the middle of the shell (Fig. 8). However similar the younger forms of this species may be to the European Muschelkalk form, *Spiriferina fragilis*, Schloth., sp., the Asiatic species differs so considerably in adult forms from the Alpine species just named, and from all related to it, that a closer comparison of their characters seems to be superfluous. But the younger specimens of *Spiriferina Stracheyi* are also recognizable by their wide hinge-line, and especially by the remarkably quick widening of the median area of the valves. But that, with regard to this feature, forms having a greater similarity occur in the Muschelkalk of the Alps, the species, *viz. Spiriferina fragilis*, Schloth., var. *latesinuata*, Phil., and *Spiriferina Possarti*, Phil., recently made known by Dr. E. Philippi (Zeitschr. d. Deutsch. geol. Gesell. 1895) show. Forms, similar to the adult ones of *Speriferina Stracheyi* have, however, as yet never been found in European triassic deposits, and even the best developed specimens of *Spiriferina fragilis* from the German Muschelkalk never possess, to my knowledge, such strikingly wing-like extensions of the hinge-line as those of *Spiriferina Stracheyi*, which give to this species the habit that so vividly recalls the palæozoic Spiriferidæ. As an example, the great resemblance to *Spiriferina octoplicata*, Sow., according to Davidson, in Quart. Journ. XVIII., 1862, Pl. I, Fig. 13 (likewise an Indian form) may be pointed out; also *Spiriferina alata*, Schloth., sp. from the permian deposits (fide King) is extremely like *Spiriferina Stracheyi.*

Moreover, we shall see that other forms, still more closely related to *Spiriferina fragilis*, are also not foreign to the Muschelkalk of the Himálayas, and these will be compared further on under *Spiriferina lilangensis*, Stol. Stoliczka himself refers to *Spiriferina* cf. *fragilis*, Schloth., from Muth in the Pin Valley. The specimen in question is however, an undeterminable fragment of a form with more numerous ribs than *Spiriferina fragilis* ever possesses.

Locality of Spiriferina Stracheyi.—The original locality of this species is, according to Salter and Blanford, the Niti Pass, which, according to Stoliczka, would be equivalent to the Rajhoti Pass. Stoliczka himself records the species from Lilang on the Lingti river, in Spiti. A greater number was collected by Diener in the Shalshal section, near Rimkin-Paiar, in those beds which Diener designates as the horizon of *Sibirites Prahlada*, which, however, might more suitably be called the horizon of *Spiriferina Stracheyi* in reference to their typical and most widely distributed form.

For the illustration of this species given on Plate IV., specimens from all the three localities were chosen.

SPIRIFERINA LILANGENSIS, Stol., Pl. IV., Fig. 2.

Spirifer (*Spiriferina*) *Lilangensis*, Stoliczka, l.c., p. 38, Pl. III, Fig 4.

Stoliczka's original specimen is before me; it comes from Lilang in Spiti. It is easily and markedly distinguished from the younger, narrower forms of *Spiriferina Stracheyi*, Salter, described above, by its much narrower hinge-line, which does not coincide with the greatest breadth of the shell but falls short of it, occupying about two-thirds of it; further by a narrower and shallower sinus, and consequently by a less elevated median lobe, as well as by a somewhat larger number of lateral ribs (7-8). The hinge-area is in proportion to its lesser breadth tolerably high, the beak slightly incurved, internally probably tripartite, and very likely, as in *S. Stracheyi*, filled with a callosity of the shell at its extremity. The surface of the shell is comparatively coarse-grained. *Spiriferina lilangensis* is distinguished from the Alpine forms of *Spiriferina fragilis*, to which it is otherwise remarkably similar, by the conspicuous coarse graining. Besides which its hinge-area is perhaps still narrower than that of *Spiriferina fragilis* generally is, and its ribbing appears to be somewhat more crowded; it might therefore be advisable to retain also this form under the name given to it by Stoliczka. Stoliczka himself compares it, on the ground of its shape, with the Rhætic *Spiriferina Emmrichii*, Suess, to which it bears, however, only a very remote resemblance, as the absence of ribs in its sinus shows.

Locality.—According to Stoliczka, near Lilang, on the Lingti River, Spiti.

Remarks.—*Spiriferina lilangensis*, Stol., var., referred to by Griesbach in his "Geology of the Central Himálayas," p. 143, from Bed 3 of his upper trias of the

Shalshal section, is not identical with this species. This species will be described below as *Spiriferina shalshalensis*, nov. sp.

SPIRIFERINA (MENTZELIA) KŒVESKALLIENSIS, (Suess) Boeckh, Pl. IV., Figs. 15, 16.

Spiriferina Kœveskalliensis, Suess, Stur, Verhandl. der k. k. Reichsanst., 1865, p. 245 *et seq.*

Spirifer Spitiensis, Stoliczka. Mém. Geol. Surv. of India, Vol. V, 1866, p. 39, Pl. III, Fig. 5.

Spiriferina Kœveskalliensis, Suess. Boeckh. Geol. Verhältn. d. südlichen Bakony, 1873, p. 175, Pl. XI, Figs. 22, 23 (first illustrations of *Spiriferina Kœveskalliensis*, Suess).

Spiriferina (*Mentselia*) *Kœveskalliensis* (Suess) Boeckh. Bittner, Brachiop. d. alp. Trias, 1890, p. 26, Pl. 34, Figs. 29—34.

Spiriferina (*Mentzelia*) cf. *Spitiensis*, Stol., sp. W. Salomon " Marmolata," 1895, p. 87, Pl. II., Figs. 7—15.

Spiriferina (*Mentzelia*) *Kœveskalliensis* (Suess). E. Philippi "Grignagebirge," Zeitschr. d. Deutsch. geol. Gesell., 1896, p. 720 (including the var. *Spitiensis*, Stol.)

With reference to the two species, namely, *Spiriferina* (*Mentzelia*) *Kœveskalliensis* and *Spiriferina* (*Mentzelia*) *Spitiensis*, there is no complete agreement as to their relationship, as may be judged by the above citations. The Himálayan species was based by Stoliczka principally upon a specimen which is distinguished by a beak remarkably thick, and strongly incurved; it partly projecting over and covering the narrow low and inconspicuous hinge-area. This specimen is represented in Fig. 16. Stoliczka himself remarks that he knew a second specimen from the same locality, whose hinge-area is more distinctly developed and whose beak is less strongly bent over than in his original specimen. The latter is indeed remarkable for the extraordinary development of its beak. The foregoing is also proved by the fact that there are two more specimens from the Himálayas before me which in this respect are not essentially distinguishable from the European *Mentzelia Kœveskalliensis*, a species very widely distributed in the Alpine Muschelkalk deposits, using this term in its widest sense. One of these specimens (figured on Pl. IV., Fig. 15) possesses just the flat, somewhat contracted shape of *Mentzelia Kœveskalliensis*, var. *microrhyncha*, from the Muschelkalk of Wengen in South Tyrol, figured in Brach. d. alp. Trias, Tab. 34, Fig. 34; only there is a somewhat greater thickening of the beak than in the Wengen specimen, which produces an approximation towards Stoliczka's original. Finally, the second specimen (fragment of the large valve) possesses a much higher and flatter hinge-area, just like that of the common European *Mentzelia Kœveskalliensis*, and can therefore in no way be separated from it specifically. It seems therefore to me most advisable to regard *S. Spitiensis* merely as a sub-species, or variety of *S. Kœveskalliensis*, in accordance with Philippi's views in his paper cited above. This would then represent among the finely ribbed species of Mentzelia pretty nearly the same type as is illustrated by forms such as var. *acrorhyncha*, or var. *judicarica* among the many shaped varieties of the smooth *Mentzelia Mentzelii* (cf. Brach. d. alp. Trias, Tab. 34, Figs. 20, 26).

Locality.—The species is now known by four specimens from the Muschelkalk of the Himálayas at the following places, *viz.*, the original specimen of Stoliczka's *S. Spitiensis* at Lilang on the Lingti River, in Spiti; Dr. Diener brought a similar specimen, which however, is almost entirely a cast, from the "Upper" Muschelkalk of Rimkin-Paiar; and Mr. C. L. Griesbach, the Director of the Geological

Survey of India, collected a specimen on the western slope of the Silakank Pass from the lower trias, Bed 122, that is, from the Ammonite Division of the Muschelkalk. It is somewhat crushed, but otherwise, especially in its outline, well preserved; and lastly, another specimen, that is, a fragment of a large valve, was found by Dr. Diener in the Bambanag section, in the beds lying between the Otoceras beds (evidently in the wider sense) and the Muschelkalk. This, as mentioned above, is nearest to the more abundant form of the European *M. Kæveskalliensis.*

Remarks.—Stoliczka raises the question (l. c., p. 39) as to the relation which Salter's *Spirifer Oldhami* bears to *S. Spitiensis.* Among the specimens which I have examined there is none which could be compared with this remarkably thick form, which according to Salter's description may rather belong to the smooth-shelled species.

RETZIA HIMAICA, nov. sp., Pl. IV., Figs. 17, 18.

From the same horizon (Bed 121) from which the above-described *Rhynchonella Griesbachi* comes, I have before me three specimens of a beautiful ribbed brachiopod, which doubtless belongs in its wider original sense to the genus Retzia. These specimens were also collected by Griesbach. They possess only a superficial resemblance to *Rhynchonella Salteriana,* Stol., under which designation they were formerly referred to. This name is, however, already marked with a query on the original label.

The outline of *Retzia himaica* is broad oval, or, almost elliptical, completely rounded; the beak is slightly incurved, and possesses a terminal opening beneath which a very low, but rather broad, Retzia-like area can be made out with tolerable distinctness. The hinge-line of the small valve is provided with little ears on both sides of the inconspicuous beak; they are, however, only slightly marked out from the rest of the surface of the shell. About ten or eleven ribs (and of these 9 to 10 being on the small valve) traverse the surface of the shell. Among these there is *no* median rib in the small valve specially marked, either by being elevated or depressed in contrast to the lateral ribs, as is distinctly the case, one way or the other, in most of the species of Retzia of the Alpine trias. The shell itself is distinctly punctate. A slight polishing of one of the specimens sufficed to prove the existence of spiral cones which are very loosely coiled and consist of at most 4 to 5 whorls.

Though the structure of the beak and the region of the area in this species combined with a punctate shell and spiral cones, prove to be quite sufficient to place this form in the genus Retzia in its widest sense, yet it differs by reason of the slight development of its area and the hardly marked median rib of the small valve so greatly from all known species of Retzia of the Alpine trias (putting aside *Retzia pachygaster,* Laube, which represents quite a divergent type) that the question may arise whether it would not be better to place it in one of the related genera of the Retzia group, So long, however, as its internal structure is incompletely known, this cannot be decided even with an approach to certainty. It is not even yet settled whether the species of Retzia of the Alpine trias can remain in this genus in the narrower sense. We shall moreover see later on that such Alpine forms of Retzia are also richly represented in the upper trias of the Himálayas.

Locality.—Three specimens from "Bed 121 of the Lower Trias," three miles south of Rimkin-Paiar, associated with the more abundant *Rhynchonella Griesbachi*, m., collected by Griesbach. As a third species which has been hitherto known in this small fauna of the "Lower Muschelkalk", the more rare *Rhynchonella* (*Norella*) *Kingi* was mentioned above.

Spirigera (Athyris, auct.) Stoliczkai, nov. sp., Pl. III. Figs. 1—17.

Athyris (*Spirigera*) *Strohmayeri* (Suess), Salter and Blanford: Palæontology of Niti, p. 70, Pl. 9, Fig. 10.
Athyris Strohmayeri (Suess), Stoliczka, l.c., p. 43.
Spirigera, nov. sp., Diener, l.c., p. 39.

The Spirigera from the trias of the Himálayas here to be discussed is not in the remotest degree identical with *Spirigera Strohmayeri* of the Norie Hallstatt Limestone, though it may be so outwardly in individual specimens (cf. Brach. d. Alpinen Trias, Tab. XV., Figs. 9—25). Both species belong even to quite distinct subgenera of Spirigera; *Spirigera Strohmayeri* is a diplospire form, while *S. Stoliczkai* belongs to the haplospire species of Spirigera.

The variability of this species is also very considerable; there are broader and narrower, thicker and flatter forms of it. The development of the sinus and the corresponding lobe also vary to a great extent. Young forms (e.g., Fig. 1.) in which the sinus is wanting have an appearance as if there were no definite characters marking them; in older specimens the breadth and depth of the developing sinus correspond mostly with the breadth and thickness of the individual, so that broader and flatter forms (e.g., Figs. 4, 6, 10, 13) generally possess a broader and flatter sinus with a correspondingly less prominent lobe, the narrower and thicker specimens (Figs. 5, 11, 14) having, on the other hand, a narrower sinus and a more strongly elevated lobe.

The greater number of the specimens under description are in the condition of casts in which the shell is preserved only at the beaks (Figs. 2, 3, 18). Only exceptionally is there a specimen with completely preserved shell (e.g., Fig. 7), which possesses tolerably regular, fine striæ of growth upon its intact surface. The substance of the shell itself is fibrous, but shows only here and there in a very incomplete manner that convergence of the fibres in the median line which is peculiar to most of the triassic species of Spirigera. The shell is strongly thickened in the umbonal region, especially at the sides, while the median part, particularly that of the large valve, does not possess this thickening. A kind of incomplete median septal thickening (Figs. 2, 15) which, however, does not seem to be constantly present, shows itself sometimes on the small valve; but here also the sides of the beak are always provided with very strong, firmly attached shell (Figs. 2, 3). At the beak of the large valve the median area between the strongly developed dental plates has always a thin shell in striking contrast to the very massive shell of both lateral areas outside the dental plates. This structure is very conspicuous in cross sections (*vide* Figs. 8, 9, 15). These thick-shelled lateral parts of the beak sometimes break off (Fig. 11); and they have in some specimens special cavities (Fig. 9). The structure of the beak here referred to is in itself sufficient to distinguish this species very strikingly from the Hallstatt one, *viz.*, *Spirigera Strohmayeri*, Suess, with its enormously thickened beak, whose greatest thickness of shell lies in the median line (type of the sub-genus Pexidella, m.—Brach. d. Alpinen Trias, p. 244, Tab. XV. Figs. 22, 23, 24). The Hallstatt species has also no dental plates in the beak, which again are very strongly developed in *Spirigera Stoliczkai*, and fuse at the point of the beak with its lateral walls (Fig. 8). These extend rather far down at the outer side of the beak (Fig. 11) as in Dielasma among the Terebratulidæ, which is noteworthy, because a typical Dielasma species occurs very frequently associated with *S. Stoliczkai*, viz., *Dielasma himálayanum*, n. sp., to be described later on. The cardinal process of the small valve is very strong and is hollowed out from the interior of the valve (Figs. 9, 16). The spiral cones consist of a very large number of whorls; that is, there may be ten or even more of them; they are haplospire; a weathered specimen (Fig. 17) shows very distinctly close to the first whorl of the principal lamella the accessory lamella which accompanies the former for a short distance. Muscular and vascular impressions are sometimes also noticeable in well-preserved casts; they are richly branched in the direction of the front of the shell and produce an indistinct striation on the cast (Fig. 10). *Spirigera Stoliczkai* distinctly differs from all known triassic species. The differences between it and the Alpine species, *viz.*, *S. Strohmayeri*, Suess, formerly regarded as identical with it, have just been specially pointed out.

Locality.—One of the most abundant species in the horizon in which *Spiriferina Stracheyi*, Salter, is found and with which it occurs everywhere in association. It is recorded from Rimkin-Paiar where it was collected by Diener in two different places at the Shalshal Cliffs. From Lilang on the Lingti River in Spiti, from whence come the specimens mentioned by Stoliczka, and according to him this species also comes from other places in Spiti, that is, Dranghar, Kuling, Khar, and so on.

The specimens found by Strachey at the Rajhoti Pass, in Niti, recorded by Salter as *Spirigera Strohmayeri*, Suess, would, in harmony with Stoliczka's views, also be identical with the form here newly described as *S. Stoliczkai*, for Stoliczka himself unites that species with his *S. Strohmayeri*, from Lilang. This is also probable for the reason that the rest of the brachiopods assigned to this fauna occur also at Rajhoti. Salter's illustration ("Palæontology of Niti," Fig. 10) agrees very well with the smaller specimens (Figs. 5, 12, 14) of our *Spirigera Stoliczkai* here figured.

Both Salter and Stoliczka record *Spirigera Deslongchampsi*, Suess, a second species from the Noric Hallstatt Limestone, from the same localities in which *Spirigera Stoliczkai* occurs. *Spirigera Deslongchampsi* is also figured by Salter

(Fig. 8); but this illustration is by no means sufficient to establish the occurrence of the species here mentioned. Stoliczka records a single specimen of *Spirigera Deslongchampsi* from Lilang, in Spiti, which shows the spirals on one side weathered out. I can scarcely doubt that he had in his mind the specimen figured on Pl. III, Fig. 17, which I assign with full certainty to *Spirigera Stoliczkai.* The occurrence of a form indentical with, or even closely related to, *Spirigera Deslongchampsi* in the horizon of *Spiriferina Stracheyi* is therefore not to be regarded as in any way proved. It may, however, be pointed out that *S. Stoliczkai* stands, as a haplospire species, considerably nearer to *Spirigera Deslongchampsi,* which is probably also haplospire, than to the widely differing diplospire *Pexidella Strohmayeri* in which most of the specimens were formerly placed. It is of course to be expected that in course of time other species of Spirigera will be found in the middle trias of the Himálayas, as has been the case with the Alps. From Lara in Spiti there comes already a much compressed form of a Spirigera which may possibly have belonged to another species. The complete absence of the type of the ribbed *Spirigera trigonella,* so generally distributed in the European Muschelkalk deposits is very remarkable.

TEREBRATULA (DIELASMA) HIMALAYANA, nov. sp., Pl. V., Figs. 1—8, 10, 11.

Waldheimia Stoppanii, Suess, Salter and Blanford, Palæontology of Niti, p. 71, Pl. IX., Figs. 6, 7.
Waldheimia Stoppanii, Suess, Stoliczka, l.c., p. 44.

In the Muschelkalk with *Spiriferina Stracheyi* there occurs, besides this typical form and in addition to *Spirigera Stoliczkai* described above, a third abundant species, a Terebratulid which has hitherto been assigned to *Waldheimia Stoppanii,* Suess, although it is not in any special degree externally like this species of the Lombardic-Esino Limestone. Also in the internal structure, at least in that of the hinge and umbonal region, the two forms differ considerably from each other, as already proved by the absence of dental plates in the Esino species, which in this respect connects it with *Cœnothyris vulgaris* of the Muschelkalk, while the Himálayan species shows by its particularly strongly developed dental plates that it belongs to Dielasma. A simple comparison of the "cardinal" sections of both species based upon the figures, Pl. V., Figs. 3, 8 (of *Dielasma Himalayanum*) and Pl. V., Fig. 9 (of *Cœnothyris vulgaris,* from an Alpine locality) makes the great differences between the two groups in this respect apparent. The cardinal section of *Waldheimia Stoppanii,* Suess, from Esino, agrees perfectly with that of *Cœnothyris vulgaris,* as I had an opportunity of convincing myself by means of specimens in the Kaiserlichen Hofmuseum in Vienna. The assignment of the species from Esino to *Cœnothyris,* which was hitherto by no means assured, might now be the most suitable, considering the relationship of the two species.

Externally also the two species, *Dielasma Himalayanum* and *Cœnothyris Stoppanii,* are very different. Even the largest forms of *Dielasma Himalayanum* hitherto known, such as those represented on Pl. V., Figs. 6, 7, 11, possess only a slightly elevated frontal lobe, whose median area is scarcely ever bordered by strongly marked slopes, or, on the large valve, even by distinct sinuses. In contrast to this, even much smaller specimens of *Cœnothyris Stoppanii*, Suess, sp. from Esino sow a sharply marked lateral bordering of the elevated frontal area, which mostly goes so far that this median area is put into relief by two parallel hollows bordering it. The illustrations in Stoppani's Petrifications d'Esino, Pl. 23, show this very well. The strongly diverging dental plates running down on the outer side of the beak in the species from the Himálayas show a further striking and differentiating character when compared with the Terebratula from Esino. The indentification of these species with each other cannot therefore be thought of.

Dielasma Himalayanum, however, is essentially distinguished from the Muschelkalk precursor of the Esino species, the well-known *Cœnothyris vulgaris*, although it resembles this species externally more closely than it does the species from Esino. Cœnothyris is also wanting, as is known, in the dental plates extending to the wall of the beak, which are so strongly developed in *Dielasma Himalayanum*. There is, however, a form generally united as a variety with *Terebratula vulgaris*, viz., *Terebratula Ecki*, Frantzen (in the German Wellenkalk), which, as I have already shown in Abhandl. der geol. Reichsanst., Band XIV., p. 5, possesses dental plates in the beak; and as it could be assigned to Dielasma on this ground, it must be employed as an object for comparison with *Dielasma Himalayanum*. Through the kindness of Prof. Eb. Fraas in Stuttgart our collection acquired a number of specimens of the south German species, *Terebratula Ecki*, from the Lower Wellendolomit from Rohrdorf, near Nagold. Some of these specimens were cut across and the cardinal sections show, in accordance with the observation, previously published, that this form closely resembles *Cœnothyris vulgaris*, especially in the junction of the dental groove supports of the umbo of the small valve, and that the dental plates in the beak, in spite of their penetrating the outer wall, are nevertheless very thin and short. In this respect also *Terebratula Ecki* is very closely related to *Cœnothyris vulgaris*, and the question may be raised whether it would not be better to put it in Cœnothyris, if one should be inclined to attribute a higher systematic value to the distinction between Cœnothyris and Dielasma. In the opinion of W. Waagen, Cœnothyris is essentially a mere variation of Dielasma, with dental plates becoming rudimentary with age; while Douvillé regards the septum of the small valve as the decisive feature, a feature which, however, considering H. Zugmayer's researches on *Terebratula gregaria*, ought not to be over-rated. At the best *Cœnothyris* might represent a small triassic collateral branch of the older type of Dielasma in which, while a quick reduction of the dental plates occurs, the septal structure of the small valve is preserved unchanged. Forms like *Terebratula Ecki* thus offer some difficulty, but they are perhaps still best united with Cœnothyris. One might then perhaps be justified in recognizing in the Rhætic forms *Terebratula gregaria*, and *T. pyriformis*, Suess (*Rhætina*, subgen. Waagen), as represented in Cœnothyris .

Terebratula Himalayana varies externally within certain limits. There are broader and narrower forms, and also the breadth of the frontal lobe somewhat varies. The shell is smooth with only indistinct fine and close concentric striations sometimes provided on the sides with very weak and irregular radial ribbing, which is here and there seen even on the casts. The shell structure is punctate.

The median septum of the small valve and the very strong and long dental plates at the outer side of the beak are quite perceptible on the cast; the rest of the impressions and elevations on the cast are of a very variable nature, and are differently developed in the different specimens. The side parts of the beak beside the dental-plate lamellæ easily break off.

Terebratula Himalayana strikingly recalls certain permian species, which also belong to the group Dielasma, as, for instance, *Epithyris elongata*, Schloth.

Locality.—In the horizons with *Spiriferina Stracheyi*, and *Spirigera Stoliczkai*, collected by Dr. Diener at Rimkin-Paiar at two different places. A specimen which was found on the 27th August, 1892, at Rimkin-Paiar, is recorded as coming from the "Upper Muschelkalk"; it cannot be separated from the other forms of this species (Fig. 7); the horizon containing *Spiriferina Stracheyi* is known to be regarded by Diener as "Lower Muschelkalk."

Not rare at Lilang on the Lingti River in Spiti.

Rajhoti Pass (according to Stoliczka), where it was collected by Strachey. The *Waldheimia Stoppanii* figured in the "Palæontology of Niti," certainly belongs here, as may once more be pointed out.

Kali River valley, from which comes one specimen, collected by Griesbach.

* * * *

I should like here to add to *Terebratula* (*Dielasma*) *Himalayana* some other species of *Terebratula* hitherto only obtained in isolated specimens from different localities; they being distinguishable only in slight details from that abundant and very widely distributed species. To the latter belongs first of all the figured specimens (Pl. V., Fig. 12) which come from the upper Muschelkalk of Rimkin-Paiar. This was assigned by Diener, l.c., p. 39, in accordance with my view, to *Terebratula* cf. *vulgaris*, Schloth., and in this specimen also I could only convince myself later of the existence of dental plates. They are, it is true, considerably weaker and shorter than in *Dielasma Himlayanum*, the frontal area being broad and scarcely perceptibly raised in its whole breadth; a fine radial ribbing is very distinctly visible on the sides.

A second specimen, figured on Pl. V., Fig. 13, comes from a dark limestone of the horizon of Ptychites, south-east of Muth in Spiti, and was brought home by Griesbach. This specimen is extremely like the poor forms of the Alpine species, *Terebratula vulgaris*, but it also has penetrating, and even rather long, though very thin, dental plates in the beak. Its frontal area is only imperceptibly raised anteriorly. I content myself here with drawing attention to those forms occupying evidently a higher horizon than the typical *Terebratula Himalayana* (which evidently finds its habitat in the older Muschelkalk deposits) and distinguishing them by the name of *Terebratula* (*Dielasma*) cf. *Himalayana*. They might perhaps be regarded as "stragglers" of this species, perhaps as intermediate forms between it and the European species of Cœnothyris. As to their relationship with *Terebratula Ecki*, Frantzen, no decision can be arrived at without further and fuller material.

TEREBRATULA (CŒNOTHYRIS) cf. VULGARIS, Schloth., sp., Pl. V., Fig. 14.

A single specimen of a Terebratula from the trias of the Himálayas is before me, which may be referred with some probability to the most abundant species of the European Muschelkalk, so far as is possible to judge from external features; it stands at any rate very near it. It comes from Lilang in Spiti, and has been assigned, evidently in consequence of some mistake, to *Athyris Deslongchampsi*, Suess, which form Stoliczka records only in one solitary specimen from Lilang and which in all probability is identical with the specimen of *Spirigera Stoliczkai* figured here on Pl. III, Fig. 17. That the form illustrated on Pl. V., Fig. 14, is not a Spirigera is explained by the punctate shell structure. The frontal area is elevated just as it is in the large specimens of *Terebratula vulgaris*, and the umbonal region of the small valve flattened; the septum, however, is not very distinct; and dental plates in the beak are certainly not present. The preservation is unfortunately very imperfect; nevertheless this specimen deserves special notice.

Locality.—Lilang, on the Lingti River in Spiti. Gümbel records *Terebratula vulgaris* from a black limestone from Balamsáli, near Dánkhar in Spiti.

AULACOTHYRIS LILANGENSIS, nov. sp., Pl. VI., Fig. 1.

Rhynchonella retrocita, Suess, var. *angusta*, Stoliczka, l.c., p. 24, Tab. III, Fig. 13.

It has already been pointed out in the Abhandl. d. k.k. geol. Reichsanstalt XIV. Band, p. 209, that Stoliczka's *Rhynchonella retrocita*, var. *angusta* only possessed a slight resemblance to the Hallstatt species of this name, which, as could also be shown, belongs to the Centronella group of the Terebratulidæ, and for which the genus Nucleatula was established (Verhandl. d. geol. Reichsanstalt, 1888, p. 126).

Stoliczka's species belongs, on the other hand, to Aulacothyris; the varietal name "angusta" given to it by Stoliczka cannot therefore be retained as a specific name for it, as this name has already been long occupied by the well-known Muschelkalk species *Waldheima angusta*, Schloth., sp., also a typical Aulacothyris.

There is only one specimen of *Aulacothyris Lilangensis* known at present, that is, Stoliczka's original specimen, cited above. It represents a strikingly flat form, that is, compressed from valve to valve, with the large valve rounded-carinate in the median line, and the small valve, widely and flatly sinuated, especially towards the frontal area, the depression of the small valve beginning already near the umbo. The shell is smooth, with the exception of very indistinct traces of radial ribbing, which appear on the sides. A sharply-marked median septum is present on the small valve, but only visible on the umbo, where the shell has undergone exfoliation; as to its length, nothing can be said. The small beak possesses dental plates which are far apart, divergent and extending to the shell-wall. The edges of the beak project very little.

From the numerous species of Aulacothyris hitherto known from the Alpine trias, only *A. conspicua* from the Hungarian locality Dernö, described by me, is allied to this species, but only in its flatter forms, such as have been figured in Brach. d. Alp. Trias, Abhandl. d. geol. Reichsanstalt, XIV. Tab. XXVI., Fig. 5.

Locality.—Lilang, on the Lingti River in Spiti; but whether from the Muschelkalk proper is questionable.

Remarks 1.—Stoliczka refers occasionally to Fig. 9 on Pl. IX., in the "Palæontology of Niti," concerning which figure nothing is however mentioned in the text. In fact it is possible that this Figure 9 might represent a species at least related to *A. Lilangensis.* What appears to be referred to and figured in the "Palæontology of Niti," p. 71, Pl. IX., Fig. 11, as *Rhynchonella retrocita*, Suess, belongs just as little to that Hallstatt species as does *Aulacothyris Lilangensis,* here described. Stoliczka has already expressed his doubts in this respect, l. c., p. 43. This form, which is unknown to me, might rather represent a Norella, similar to *Norella Kingi* described above. Such forms seem to occur more generally distributed in the trias of the Himálayas in different horizons.

2.—From the whole region of those Muschelkalk deposits from which the above-described brachiopods come, there are no remnants at all of lamellibranchs, which, on the ground of their preservation would be suitable for description and illustration. It may however be pointed out here that a few lamellibranchs from these, or related deposits, have been described by C. W. Gümbel. Stoliczka records species of lamellibranchs which might have come from these deposits.

b. Brachiopoda and Lamellibranchiata from the Transition-Horizon between the principal complex of the Muschelkalk and the overlying complex of the so-called "Daonella-beds," and also from the Horizon of Daonella indica (designated by Diener as the Aonoides-beds).

If I assign the beds from which the species now to be described are derived still to the middle trias, or the Muschelkalk, I have several reasons for so doing. First, the equivalents of the Ladinic series of the Alpine trias must lie just in this place in the regular and unbroken succession of beds, which, according to all accounts, is said to exist here. Secondly, Dr. Diener, when on the spot, assigned these beds still to the Muschelkalk in accordance with their position. And thirdly, the "chorological interpretation" by means of which E. v. Mojsisovics would like to allocate these formations to his Aonoides zone is by no means so convincing that the possibility may seem to be excluded thereby of their being assigned to a lower and hence a Ladinic horizon. Mojsisovics has been obliged to adopt the expedient of dividing the Aonoides zone in order to make his argument more plausible, and in doing this he reverts to that older view in which the Aonoides zone was not looked upon as equivalent to the Lunz-Raibler beds, but older than these. These reasons seem to me quite sufficient to link the beds here in question more closely to the principal Muschekalk complex of the Himálayas than to the overlying so-called Daonella-beds, which, however, so far as could be judged hitherto mostly contain Halobia from the group of *Halobia rugosa,* while species of true Daonella seem to be confined almost, if not entirely, to the transition formations which are here to be discussed.

AULACOTHYRIS NILANGENSIS, nov. sp., Pl. VI., Figs. 3—7.

This is one of the species of Aulacothyris, hitherto known from the triassic deposits, which seem to be without any defined and distinctive characteristics. Outline oval, rounded, or a little inclined to be five-sided; the thickness of the shell rather considerable. The lines of junction of the valves lie in one plane; the frontal outline is level, not in the least bent down in the manner of the greater number of species of Aulacothyris; the small valve possesses a trace of a median sinus near the frontal outline. The rather coarsely punctate shell shows near the frontal area mostly strong concentric lines of growth. In the small valve there is a strong median septum, reaching half its length; in the beak there are dental plates which are near to one another and extend to the shell-wall. The last two features decidedly suggest that the form belongs to Aulacothyris, though the presence of the Waldheima loop in the interior could not be proved.

There is not a single one among the numerous species of Aulacothyris in the Alpine trias which could be placed particularly near to *A. Nilangensis.* Only a few of them, especially *A. pulchella,* m., from the Noric Hallstatt limestones, have not a depressed frontal area. Perhaps the most closely related to the Asiatic species are certain forms of *Aulacothyris dualis,* m., from the Carnic Hallstatt limestones, but these also become larger and develop a median depression in the small valve, in consequence of which the frontal outline bends down.

Locality.—In the moderately thick beds immediately overlying the chief mass of the Muschelkalk with *Ptychites,* regarded by Dr. C. Diener as the representative of the Aonoides zone, these beds being divided into the lower crinoidal limestone, and an overlying Halobian bed. This Halobian bed is the horizon of *Daonella indica,* n. sp., which will be described further on. From this horizon of *Daonella indica,* and, moreover, from fragments of the Daonella rock itself, which Dr. Diener has brought from Rimkin-Paiar, are derived the two specimens of *Aulacothyris Nilangensis* figured on Pl. VI., Figs. 3, 4. More frequently I got the same species from a bed of dark colour entirely filled with *Daonella indica.* This bed recalls in every respect the rock of the Shalshal section, previously mentioned, and from which a slab of considerable size from the pass situated between Hop Gádh and Dogkwa Aúr meadow, N. E. from Tsang Chok Lá (Hundés), was brought home by Mr. C. L. Griesbach. It is recorded as belonging to the Daonella horizon (Black Limestone) of the upper trias. In all probability one has here to deal with that division of beds, mentioned above, lying at the base of the whole immense mass of the "Daonella beds," forming the uppermost part of the

Muschekalk. In breaking up that slab in order to get better preserved specimens of Daonella, there were also obtained a great number of mostly small brachiopods, the most abundant of which was the species of *Aulacothyris Nilangensis*, just described. There are about fifteen specimens from this locality, three of which have been figured on Pl. VI. Figs. 5, 6, 7, and of these one is a strikingly elongated form. This plate also contains the remaining species of the small brachiopod fauna from the horizon of *Doanella indica*. The latter will be described further on.

SPIRIGERA HUNICA, nov. sp., Pl. VI., Figs. 8—13.

This species which occurs associated with *Aulacothyris Nilangensis* in the horizon of *Daonella indica*, though bearing every resemblance in outline to *Spirigera Stoliczkai*, already described from the Muschelkalk, is narrower than that species, and is distinguished from the narrowest forms of it by its broader frontal lobe, with which is associated a weaker or obsolete median depression of the large valve next to the frontal lobe. In the formation of the beak the two species are also widely distinguished. While in *Spirigera Stoliczkai* (Pl. III. Figs. 8, 9) the sides of the beak, outside the dental plates, are thick-walled and the back of the beak between the dental plates only possesses a thin shell, the opposite is the case in *Spirigera hunica*, that is to say, the median part of the beak is thickened and its sides thin-shelled. In *S. hunica* dental plates extending to the shell-wall are present. The median umbonal area of the small valve is likewise thick-shelled and forms a kind of broad and flat septum which easily breaks off leaving a shallow furrow in the cast. The shell is minutely fibrous, without any trace of punctation, which combined with the presence of a terminal opening in the incurved beak proves incontestably the Spirigera nature of the species, though, owing to lack of material, the spiral cones in it could not be shown to exist. Thus for the present it is not possible to decide with which group of Alpine Spirigera this species is to be united; though, judging by the external features, it might stand nearest to Pexidella.

Locality.—A single loose specimen was collected by Griesbach in the "Daonella beds," on the road from Hop Gádh to Dogkwa Aúr encamping ground in Tibet. This (figured on Pl. VI. Fig. 13) certainly comes from the horizon of *Daonella indica*, from which, besides numerous forms of *Aulacothyris Nilangensis*, also the smaller specimens figured on Pl. VI. Figs. 10, 11, were obtained. I should like also to leave for the present Fig. 12, Pl. VI. in this species, though the specimen is considerably broader than those mentioned before. The smaller forms, Pl. VI. Figs. 8, 9, on the other hand, are to my mind very doubtful as to their position. They have the appearance of Aulacothyris, but have no septum, the shell is not punctate, and they show the structure of the beak of the larger forms as described above. They are perhaps young forms of *Spirigera hunica*.

A single large valve of this species, also from the horizon of *Daonella indica* from the Shalshal section, near Rimkin-Paiar.

RHYNCHONELLA (NORELLA) KINGI, nov. sp., Pl. VI., Figs. 14, 15, 16.

Species of Norella, with folds on the front margin, occur in the trias of the Himálayas already in the deep-seated layers with *Pseudomonotis Griesbachi* of the Otoceras beds (cf. above, *Rhynchonella* (*Norella*) *procreatrix*). A similar form, also from the horizon of *Norella Griesbachi*, was described as *Norella Kingi*, and figured on Pl. II., Fig. 16. From the horizon of the *Daonella indica*—on the upper boundary of the Muschelkalk—there are again similar species of Norella present, which can not even be separated specifically from the above-described *Norella Kingi*. They are very pretty little shells of a nut-like shape, which represent among the Rhynchonellidæ the same typical form as the Aulacothyris species do among the Terebratulidæ. The shell, which shows a distinct fibrous structure, is smooth, provided with delicate striæ of growth, and only ornamented on the front margin and on its contiguous sides with short, weak little folds, whose number is not at all constant. Some specimens show only two of them on the front margin, others as many as four; still more variable in number and strength are the lateral folds. The sinus of the small valve is broad and shallow, and the median part of the large valve forms a broadly-rounded back, while the sides are a little flattened. The beak is small and pointed; its margins are rather sharply marked and slightly hollowed, or overhanging. The shell appears to be somewhat thick on the sides of the beak, whilst a median band on the back of it is thin-shelled. Short dental plates extending to the wall of the umbonal region separate these three regions, and their presence is often the cause of the breaking off of the lateral portions. The specimen of *Norella Kingi*, already described from the horizon of *Rhynchonella Griesbachi*, evidently possesses this structure of the beak. It is scarcely to be distinguished from the specimen figured on Pl. VI. Fig. 15, but if anything, it is a little more inflated. Its similarity to *Norella Rosaliæ*, Sal., has been pointed out above.

Locality.—In the horizon of *Daonella indica*, associated with *Aulacothyris Nilangensis*, in the Shalshal Cliff, near Rimkin-Paiar, obtained from rock specimens of his "Halobia-beds" of the "Aoneides horizon;" collected by Diener on the 27th and 28th August, 1892.

Very near to this form stands a second, which occurs in the same beds *viz*;—

RHYNCHONELLA (NORELLA) TIBETICA, nov. sp., Pl. VI., Figs. 2, 17, 18.

This is distinguished from *Norella Kingi* only by the absence of the fine folds on the frontal margin, although they agree in size; it is, therefore, nothing but a perfectly smooth sub-species of *Norella Kingi*, to which it could be united as *var. tibetica*. Also the figured specimen (Pl. V. Fig. 2), in which I was able only at a later period to expose completely the fine Rhynchonella beak, belongs here; it connects by the character of its outline the two original specimens, Fig. 17 and Fig. 18.

Locality.—Associated with *Norella Kingi* in the horizon of *Daonella indica* in the beds immediately overlying the Hauptmuschelkalk (Diener's "Halobia-bed" of the "Aonoides zone") in the section of the Shalshal Cliffs, near Rimkin-Paiar; one specimen, figured Pl. VI. Fig. 2.

From the horizon of *Daonella indica*, near Dogkwa Aúr, in the Hop-Gádh district, Tibet; from whence come the two specimens, Pl. VI., Figs. 17, 18.

RHYNCHONELLA RIMKINENSIS, nov. sp., Pl. VI., Fig. 19.

A narrow but tolerably thick Rhynchonella, with high, vertically flattened, lateral hinge-margins, and broadly-expanded frontal lobe in the large valve; to this lobe belong four short little folds; and the rest of the shell is smooth and unornamented. The beak is a pointed small Rhynchonella beak, with distinct triangular opening under it; that this form belongs to Rhynchonella thus admitting of no uncertainty. Among the forms of the Alpine trias, the narrow smooth *Rhynchonella intercurrens*, m., is perhaps most closely related to this species, without being, however, specifically identical with it; for apart from the entire absence of ribs, the flattening of the umbonal lateral margins exists in a much slighter degree in *Rhynchonella intercurrens*. In this respect the new species comes nearer to *R. halophila*, m., a form likewise without ribs, but which, however, possesses, as a rule, a very sligtly inflated small valve, while in *R. Rimkinensis* both valves are equally strongly inflated. *Rhynchonella halorica*, m., is again distinguished by the absence of the frontal lobe, the line of junction of the valves lying completely in *one* plane. In any case it is to the Hallstatt species that *R. Rimkinensis* is nearest in relationship.

Locality.—In a bed of grey crinoidal limestone immediately *under* the beds of *Daonella indica*, in the section of the Shalshal Cliffs, near Rimkin-Paiar. One specimen collected by Diener. There is only the cast of a small Myoconcha, sp., from this bed, which is figured on Pl. VII., Fig. 21.

DISCINA, sp., Pl. VI, Fig. 20.

Two specimens of a small Discina were also found in the horizon of *Daonella indica* in association with brachiopods in the rock-specimens from Dogkwa Aúr.

To the illustrations of the brachiopods from the horizon of *Daonella indica*,—the horizon forming the boundary between the Muschelkalk and the upper triassic deposits,—the descriptions of the lamellibranchs coming (with certainty, or, in all probability) from this horizon and exclusively belonging to the genus Daonella will be added later on (Pl. VII, in part).

DAONELLA cf. LOMMELI, Wissm., sp., Pl. VII., Figs. 1, 2.

Daonella Lommeli, Wissm., sp. E. v. Mojsisovics, in Abhandl. d. k. k. geol. Reichsanstalt, VII. Bd. Heft 2, 1874, p. 19, Tab. II., Figs. 13, 14 (with the older literature).

Halobia Lommeli, Wissm., sp. A. Rothpletz: Die Perm-Triasund Juraformation auf Timor und Rotti; in Palæontographica, 39 Bd., 1692, p. 93, Tab. XIV., Figs. 11, 12 (6 ?).

Daonella (or *Halobia*) *Lommeli* has for some time, as is well known, been recorded also from the trias of the Himálayas. E. v. Mojsisovics has however already pointed out (l. c., p. 4) that these records refer either directly to different specific forms, or that they are not sufficiently well established. Whether Stoliczka's very decidedly expressed statements (l. c., p. 44) upon the occurrence of this species in Spiti actually referred to it had to remain undecided for Mojsisovics, for Stoliczka neither figured nor described those specimens. Stoliczka alludes in his references to the literature on the subject to the form designated in the "Palæontology of Niti" as *Halobia Lommeli*, and this considerably reduces the weight that one could attach to his statements regarding it. It appears to me, judging by the specimens which I have before me and which were collected by Stoliczka in Spiti, for instance, from Khar, Kuling, and so on, and which are likewise named (probably by Stoliczka himself) *Halobia Lommeli* (Pl. VII., Figs. 11, 12, belong to it), that neither Stoliczka nor Strachey knew the true *Halobia Lommeli* from the Himálayas. Strachey as well as Stoliczka may have obtained their specimens, which they regarded as *Halobia Lommeli*, from that deposit of Daonella which has already so often been indicated as the horizon of *Daonella indica*, so widely distributed and so remarkable, as it would seem, in the triassic deposits of the Himálayas. The form, figured in the "Palæontology of Niti," can at least with certainty be assigned to the species to be described further on, and also the greater number of those specimens named *Halobia Lommeli* by Stoliczka may be attributed, not to this species, but likewise to *Daonella indica*.

Dr. Rothpletz makes mention in his work, cited above, of *Halobia Lommeli* from Rotti Island in the Indian Archipelago. His illustration of this species (l. c., Tab. XIV, Fig. 6), supposing that it is a faithful one, would however by no means demonstrate the correctness of his determination, for it shows undoubtedly the absence of the dichotomy of the ribs, so striking in that species.

I might be permitted here to make a long digression. According to A. Rothpletz (l. c., p. 94), *Halobia Lommeli* may also occur in the Hallstatt Limestone. This statement rests upon the fact that Rothpletz declares *Halobia Hœrnesi*, Mojs., to be identical with *H. Lommeli*, which however is decidedly an error. *Halobia Hœrnesi* is distinguished specifically from Daonella Lommeli by the form of its ear. This is twice as wide as that portion of the shell which may be regarded in *D. Lommeli* as corresponding to the ear, and well developed, strongly projecting above the surface of the shell, and divided by a radial furrow into a narrower upper (outer), and a lower (inner) radial portion which is more than twice as broad as the upper, and moreover strongly convex; this latter being again sub-divided into three parts by two furrows which are placed on its sides. Nothing of this complicated ornamentation of the ear is to be found in *Daonella Lommeli*. The illustration of *Halobia Hœrnesi*, Mojsisovics, (l.c. Tab. V. Fig. 3), shows the character of the ear pretty faithfully, and the description of the species contains nothing whereby its identity with *Daonella Lommeli* could be judged, as is the case, on the other hand, with Rothpletz's.[1]

The statements concerning the occurrence of *Daonella Lommeli* elsewhere than in the Alps may thus be taken on the whole with a certain reservation. As to the presence of this species in the trias of the Himálayas, it could be shown that exact data have hitherto been in no way forthcoming.

It seems to have been reserved for Mr. Griesbach to make a discovery which may result in establishing the occurrence of *Daonella Lommeli* also in the trias of the Himálayas. The discovery was made in the district south-east of Muth in Spiti in the complex of the so-called Daonella beds (which, according to Griesbach, begin, as is well known, immediately above the Muschelkalk with *Ptychites Gerardi*), and consists of a specimen of rock, of a dark, somewhat dolomitic, very argillaceous and fissile limestone, the surfaces of its rather even layers being, as it were, sprinkled over with numerous minute particles of white mica. A similar rock cannot be duplicated in the rock-material from the trias of the Himálayas which is before me. On one of the surfaces of this rock lie, side by side, the two valves figured on Pl. VII., Figs. 1 and 2, which undoubtedly belong to *one* species, a very young form with a completely preserved outline, and a larger one whose umbo and anterior hinge-margin are wanting. Both valves are right valves, both are natural casts of the inner side of the shell, because their radial furrows appear as ribs upon them. They have been drawn from plaster casts. As nothing is preserved of the thin shell, the casts give an exact picture of the surface. The outlines agree best with those of *Daonella Lommeli,* with that remarkably beautiful specimen, for instance, from Wengen, which Mojsisovics illustrates, l. c., Pl. II., Fig. 13. The shell has, at the fusion of the posterior with the lower margin, as also in the two Indian specimens, a more decided diagonal extension than the illustration indicates; the figure of the larger specimen, specially at this point, is much too schematic in the way in which it is rounded. The ribbing of these Indian forms agrees also perfectly with that of the South Alpine specimens and can be affirmed to be completely identical. The number of the strongest or primary furrows amounts to from 14 to 15, which is also the case with most of the Alpine specimens, and the splitting of the ribs is very regularly dichotomous, a chief characteristic of *D. Lom-*

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[1] There is as little identity between *Halobia Hœrnesi,* Mojs., and *Daonella Lommeli,* as there is to all appearance between the Rotti specimen assigned by Rothpletz (l.c. Tab. XIV, Fig. 18) to *Halobia Cassiana,* and the true *D. Cassiana,* Mojs. In *D. Cassiana,* as well as in *D. Richthofeni* there remain only small portions near the hinge-margins free of ribs, so that these species, so to speak, connect the two groups of *D. Moussoni* and *D. Tyrolensis.* If one appealed to Mojsisovics' Tab. I., Figs. 2—5, as authoritative, Figures 2 and 3 of which represent *D. Cassiana,* but Figures 4 and 5 *D. styriaca,* both from the Hallstatt Limestone of the Rothelstein, the objection could be raised that the differences given by Mojsisovics in the number of ribs are not tenable, for in his *D. Cassiana,* Fig. 2, about 35 ribs may be counted, whilst his *D. styriaca,* Fig. 5, possesses about 45 ribs, although, according to his own statement, *D. styriaca* should only have half the number of ribs possessed by *D. Cassiana,* a difference which at the same time, is given as the only one existing between the two species. The Carnic Hallstatt forms of Rothelstein, which Mojsisovics separates into the two species, *viz.,* *D. styriaca* and *D. Cassiana,* not only merge into each other, but are simply specifically inseparable and Mojsisovics' specimens, Tab. I, Figs. 2, 3, belong to *D. styriaca.* In fact it was possible to expose the rudimentary ear just as it occurs in *D. styriaca,* in the specimen, Fig. 2, so that there can be no doubt that Mojsisovics' Hallstatt species, *D. Cassiana,* is nothing but *D. styriaca.* The statement as to the occurrence of *D. Cassiana* in the Hallstatt Limestone seems thus at present insufficiently vouched for. Rothpletz's statement about *Halobia Cassiana,* referred to above, must also be estimated from this standpoint.

meli, by which means the strikingly bundle-like ribbing in this species is produced. The secondary furrows also arise in the Indian specimens already near the umbo; the young specimens (Fig. 1) appear therefore more closely ribbed than is the case with many Alpine specimens of similar size, which often show only the primary furrows. But this feature is not general in the Alpine fossils; for the specimens from Wengen, from Mundevilla, in the Abteythale, and in other places in South Tyrol, possess the same close ribbing as the two Asiatic species. Also the varying strength of the ribs in any given shell is developed in the same manner as in the European specimens; the strongest and deepest radial furrows are in the middle and in the region of the posterior, diagonal extension of the shell; in the latter position they are, at the same time, the most crowded; and towards the anterior hinge-margin they become gradually, but towards the posterior proportionally rapidly weaker. The broadest and most regular bundles of ribs are tripartite by furrows of the second, third and fourth order, thus containing 8 ribs between two primary furrows. Where numbers like 6 or 10 occur, the division does not take place simultaneously, the complete dichotomy, however, prevailing. It is, moreover, only natural that an irregularity once occurring in the division of a bundle of ribs should augment with the growth of the shell.

After a minute comparison of Alpine specimens from different localities, I cannot doubt that in the two forms figured on Pl. VII., Figs. 1 and 2, from Muth, in Spiti, the true *Daonella Lommeli*, from the trias of the Himálayas, is really for the first time before me. If, nevertheless, I have named these still with some reservation, the reason for this is to be sought only in the scanty material hitherto representing the Indian form.

A short time ago A. Rothpletz declared the generic name "Daonella" to be superfluous, and said that it would be sufficient to distinguish special groups within the genus Halobia, to which the species of Daonella were again to be assigned. The two chief groups which were then again to be distinguished would certainly be that of true Halobia and that of Daonella; and therefore it would perhaps be simpler to retain; the already existing name for that group, which would not prevent the definition of the two genera and their limitations with respect to each other from being perhaps somewhat modified in course of time. Rothpletz puts perhaps a somewhat exaggerated value upon the indication of an ear-like formation, which is found in some species of Daonella, particularly in *D. Lommeli*, as an argument for the reunion of the two genera, whose intimate relationship has not however been called in question by anybody. In making the following remarks I refer to the description which Rothpletz has given on the matter (l. c., p. 93). Large specimens of *Daonella Lommeli* from Corfara, which lie flattened in the rock, possess, beside the anterior hinge-margin, a narrow space, free from ribs and consequently from furrows. This space is generally somewhat concave or depressed, and is bordered at the hinge-margin itself by a distinct rim, from which the shell towards the outer side falls steeply away, or rather sinks into the rock. In Rothpletz, p. 93, Figs. 1 and 2, this rim might easily be taken for the outermost rib, bordered by a furrow on the inner side, but such a rib does not exist in reality. One can recognize the bordering of the little ear-area towards the outside in *Daonella*

Lommeli as a rim, and this only a very indistinctly pronounced one, which is remarkably perceptible, especially in the uncrushed specimens, Tab. II, Fig. 13 of Mojsisovics. This rim corresponds at the same time with a curvature of the hinge-margin towards the inner side, that is, in other words, of the hinge-margin of one valve towards that of the other valve, by which a kind of groove or cavity is created, in which probably lay the ligament, as is also assumed by Rothpletz. The little ear-area itself remains also in large specimens of *D. Lommeli* very narrow; measured at thirty mm. distance from the umbo it is scarcely four mm. wide, and this corresponds with valves sixty mm. in height. The inflation of the little ear-area does not in the least project beyond the neighbouring shell surface, and thus its area does not appear distinctly defined from the rest of the shell, and is not further sub-divided. There is not the slightest emargination on the anterior margin of the shell, between the latter and the little ear-area; the striæ of growth continue completely uniform across this area, and there is not a trace of an incurvature of the striæ which generally marks a byssal opening. The "ear" of Daonella is therefore, properly speaking, scarcely to be recognized as such. But if it is hardly possible to speak of a true ear in *Daonella Lommeli*, it is still less so in species such as *D. Taramelii*, *D. Cassiana* and others. It is possible, and it is not denied here, that there are forms about which one may actually remain doubtful as to whether to place them, on the basis of the generic diagnoses hitherto employed, in Daonella or in Halobia (such a form, for instance, being *Daonella styriaca*, Mojs.). But where in nature do we not have transition forms, and where are there sharply separated generic groups of related organisms? The greater number of species of Halobia incontestably possess a formation of the ear at the anterior hinge-margin, which is distinguished essentially from the very incomplete character of the little ear-area of *Daonella Lommeli* and related species.

The ear in Halobia is almost without exception more or less strongly raised above the adjacent shell surface, and is sharply and distinctly marked out from it, it thus being semiconical in shape. It is often characterized at the border by an emargination, almost always sub-divided by radial furrows, and falls into at least two divisions, of which the inner often shows by the striæ of growth being directed inwards that it corresponds with the byssal opening. Among the species with flatter ears *Halobia rugosa* (and its related forms from Balia in Asia Minor, cf. Jahrb. d. geol. Reichsanst., 1891, p. 100, 1895, Tab. XI., Figs. 10, 11), *Halobia austriaca*, Mojs., and *H. Halorica*, Mojs., as well as *H. insignis*, Gemm., have these inwardly directed striæ of growth of the byssal opening very distinctly developed; and in a geater number of closely related forms their existence may be assumed on account of this relationship. In other groups, especially in those of *H. plicosa* and *H. distincta*, in which they could not hitherto be observed, the formation of the ear itself is such that these groups can at once be placed in Halobia without these striæ being present. The characteristics of the genera Daonella and Halobia given at that time (l. c., p. 8) by Mojsisovics might therefore be altered to the following effect: for Daonella they would be, instead of "without ears,"—

"Without distinctly defined ear, or, with very incompletely developed ear, or better, little ear-area, not raised above the surface of the adjacent shell, not sub-divided, not provided with an emargination and byssal opening;"

for Halobia, on the other hand :—

> "With a distinctly marked anterior ear, raised above the shell surface, of semi-conical shape, sub-divided by radial furrows, and often provided with a true byssal opening."

For the reasons just mentioned the genus Daonella, Mojs., can, I think, be retained, and consequently I have allocated the species here in question, in opposition to Rothpletz's procedure, to *Daonella Lommeli*, Wissm., sp.

Locality of Daonella Lommeli.—South-eastward from Muth, in the Pin Valley, Spiti, in a rock which has already been described. Perhaps we have here in this quite isolated occurrence an indication that the Ladinic deposits (cf. Diener, l. c., p. 49), hitherto missing in the trias of the Himálayas, are really present in it, though perhaps only in insignificant development and thickness, much in the same way in which they occur in the north-east Kalkalpen; they thus having met with less attention. They should, therefore, be looked for in the upper portions, that is, on the upper boundary of the Muschelkalk deposits of the Himálayas, especially, I may add, at that place where the widely-extended beds with *Daonella indica* occur, which possibly likewise fall into the Ladinic group of beds as already mentioned.

DAONELLA SPITIENSIS, nov. sp., Pl. VII., Fig. 3.

A Daonella of quite unusual habit. It possesses the beautifully rounded outline of *Daonella Moussoni*, Mer., sp., but not its distinct, though fine, radial grooving. A right valve, the only specimen before me, is very slightly inflated, its hinge-margin straight, the umbo markedly directed forwards. The surface is covered with about thirty very slightly raised radial ribs, which, however, are not separated by the usually distinct furrows, but only by very indistinct, slight, radial depressions, so that the whole ribbing is only obscurely indicated. The illustration renders this kind of ribbing too strongly marked. Here and there one of the chief ribs undergoes subdivision. The striæ of growth are, if possible, still more indistinctly marked.

No species is known to me which I could compare with *D. Spitiensis.* The unusual ribbing distinguishes it from all species hitherto described. The two species from the Bakonyerwald, *viz.*, *D. Bœckhi* and *D. obsoleta*, Mojs., which one might be inclined to compare it with, are distinguished by their longer hinge-line as well as by their almost still less distinct radial sculpture. In its outline *D. Spitiensis* stands extremely near to *D. Moussoni* of the Lombardic Muschelkalk, as already mentioned. As upper triassic forms, which might be comparable with it, are yet unknown, it might well be supposed that *D. Spitiensis* is perhaps a Muschelkalk species, that is, that it is derived from the horizon of *Daonella indica*, as is the case with the greater number of species of Daonella which have hitherto come under my notice from Spiti.

Locality.—In compact black limestone, with rusty brown, earthy, weathered surface, from Kuling in the Pin Valley, Spiti, brought thence by Stoliczka, and designated "Halobia Lommeli."

DAONELLA INDICA, nov. sp., Pl. VII., Figs. 4—11.

Monotis (*Halobia*) *Lommeli*, Wissm., Strachey's Palæontology of Niti, p. 68, Tab. 9., Fig. 1.
Halobia Lommeli, Wissm., Stoliczka, l. c., p. 44 (the greater part).
Daonella, nov. sp. Mojsisovics, Abhandlungen der geol. Reichsanstalt, VII. ½, 1874, p. 35 (4).

The form newly established here as *Daonella indica* in contrast to the other species of Daonella hitherto known from the trias of the Himálayas, is a species not only occurring in large numbers of individuals in beds, but also, as it seems, in a special horizon and widely distributed.

The outline of this species is rounded, the height greater than its breadth, the hinge-margin straight, the umbo projects little above it and lies somewhat excentrically, or almost in the middle of the hinge-margin. There is no anterior Halobian ear present; the radial sculpture begins, in fact, close to the hinge-margin, without leaving a space differently sculptured, or otherwise characterized as 'ear.' The form is, therefore, to be placed in Daonella. Both the ribs and the radial furrows begin already very near the umbo in a great number, about thirty to forty; only a very small umbonal part remaining free from them. At a very slight distance from the umbo, the greater number of the ribs are divided. The secondary furrows, however, do not attain the full strength and depth of the primary furrows up to the margins, whereby the greater part of the ribs, at least in the centre of the shell, appear continuously and very regularly bifurcated. Only very exceptionally a tripartite rib occurs here and there, and is then, as a rule, unsymmetrical, that is, one of the two secondary furrows begins much sooner than the other, or, in other words, one of these two furrows is a tertiary one, or a furrow of the third order. Near the hinge-margins the ribs are often single, or at least they do not bifurcate so generally and so regularly as the middle ones, without, on the other hand, differing from them essentially in breadth. The striation of growth is marked only in a very slight degree.

There are a number of Alpine species which must be compared with *Daonella indica*. First, there are the two St. Cassian species, *viz.*, *D. Cassiana* and *D. Richthofeni*, which, especially the latter, demand such comparison. In *Daonella Richthofeni*, however, the ribs bifurcate already nearer the umbo, and they are, therefore, at the same distance from it, much more numerous than in *Daonella indica*. In *D. Richthofeni* as well as in *D. Cassiana*, an irregularity of the ribs, that is, a bifurcation of them towards the margin, is scarcely indicated at all, for the secondary furrows quickly assume the strength of the primary ones. Finally, both of the St. Cassian species belong to those species of Daonella the ribbing of which gradually dies away near the hinge-margins on both sides, while *D. indica* belongs to that group in which the ribbing reaches the hinge-margins almost in full strength, without leaving a perceptible space free from ribs. This group would, according to Mojsisovics' classification (l.c., p. 7), be that of *Daonella Tyrolensis*, in which, moreover, the primary furrows are distinctly differentiated by their strength from the weaker secondary furrows, without producing by further progress of the bifurcation of the ribs a bundle-like grouping of the latter, as in the *Lommeli* group. The species of the *Tyrolensis* group which are here collated are *D. Tyrolensis* itself, with its accessory form *D. badiotica*, Mojs., further *D. Parthanensis*, Schafh., sp., which is unfortunately very insufficiently known.

Daonella Tyrolensis., Mojs., is less oblique, almost equilateral, considerably higher, its umbo is more decidedly central, and its ribbing distinguished by a frequently occurring *regular tripartite* character. What is said of this species can also be said of *D. badiotica*, which is only a little more oblique than *D. Tyrolensis*, but is otherwise scarcely specifically distinguishable from it. There remains therefore for comparison with *D. indica* only *D. Parthanensis*, one of the most imperfectly known species of all hitherto described. Recently the opinion has been expressed (Rothpletz, Salomon) to the effect that the identity of *D. Parthanensis* and *D. Tyrolensis* is established. Were this really the case the foregoing remarks about the differences between *D. indica* and *D. Tyrolensis* could also be applied to *D. Parthanensis.* Supposing that *D. Parthanensis*, so insufficiently known, were nevertheless differentiated from *D. Tyrolensis*, as is possible, to judge by the ribbing of both, *D. Parthanensis* would always be distinguished from *D. indica* by the fact that the former possesses strikingly broader ribs near the anterior hinge-margin than in the centre, a distinction in the ribbing which does not exist in *D. indica.* Nevertheless it is indisputable that *D. indica* stands very near to *D. Parthanensis*,[1] but a fair comparison cannot at present be made between *D. Parthanensis* and the former on account of the very insufficient material hitherto available. Strictly speaking, *D. Parthanensis* ought to have been annulled long ago as a species, as neither the older nor the later describers have been able to put forth a correct interpretation of this "species."

Locality of Daonella indica.—The species is widely distributed in the trias deposits of the Himálayas. I have before me specimens of it from a number of places: Shalshal section near Rimkin-Paiar, from a bed which Diener, when on the spot, took to be the top of the Muschelkalk complex, but later attributed to the Aonoides beds. The rock is quite filled with confusedly embedded shells of this Daonella, which are unfortunately mostly broken, and contains small brachiopods, isolated and scattered among them, which have already been described.

Griesbach evidently collected the same rock with Daonella fragments further to the south-east of the mountains, opposite to the Ralphu glacier on the left side of the Lissar Valley. It seems to be more widely distributed to the north-west of the first-named locality.

First may be mentioned the large slab of Daonella rock brought home by Griesbach, from the pass leading to the Dogkwa Aúr meadow in Hóp Gádh, north-east from Tsang Chok Lá, from which slab not only the greater part of the brachiopod fauna, figured on Pl. VI. is derived, but from which also the original specimens of most of the illustrations of *Daonella indica* on Pl. VII, (Figs. 4 - 9) are taken. This rock is also quite filled with shells of Daonella, which however are here also in a very fragmentary condition.

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[1] Compare on this subject, Th. Skuphos in Geogn. Jahresheften des kön. bayr. Oberbergamtes IV., 1891, p. 51 (Sep.), Tab. Figs. 3, 4, 5, and further, W. Solomon, in his work on the Marmolata, Palæontographica, 1895, p. 154.

Ganes-Ganga (perhaps identical with the locality Gunes-Gunga in Strachey ?); to this locality belong probably the specimens figured in the "Palæontology of Niti." The rock is identical with that of the localities named above.

Stoliczka mentions beds of rock in Spiti which consist almost entirely of the shells of *Halobia Lommeli*. This statement may also point to *Daonella indica*, as Stoliczka has determined other specimens of *D. indica* to be *Halobia Lommeli*, as already mentioned. To this belong the large specimens from Khar in the Pin Valley, of which the best preserved is figured on Pl. VII, Fig. 11.

A form lies before me, perhaps different from *D. indica*, to which possibly Stoliczka's remark might refer, *viz.*, that *Halobia Lommeli* occurs in beds almost made up of this species. This form comes from Kuling in the Pin Valley, and is illustrated on Pl. VII., Fig. 12. It is distinguished from *D. indica*, so far as the rather deficient preservation permits of recognition, by a somewhat different outline, the umbo lying more to the one side, and above all by considerably wider and much more irregular ribbing.

III.—BRACHIOPODA AND LAMELLIBRANCHIATA FROM UPPER TRIAS (THE KEUPER FORMATION) OF THE HIMÁLAYAS.

The upper triassic or Keuper deposits succeeding the Muschelkalk deposits (taken in the preceding pages as somewhat extended upwards) are divided, according to Griesbach, into two great natural groups, as in the Alps—a lower one, poor, for the greater part at least, in limestone, and an upper one, rich in limestone. Griesbach only indicates the lower of the two specially as upper triassic, while he admits the upper to be rhætic (according to F. v. Hauer's precedent). It comprises, therefore, at all events, not only the equivalents of the Kössen beds, which, however, at least in the material that I have investigated, cannot be proved, but specially those thick Limestone and Dolomite masses of the uppermost trias which are to be regarded as the representatives of the Main Dolomite and Dachstein Limestone horizon of the Alps. The lower group, poor in limestone (the upper trias in Griesbach's restricted sense of the term) is, on the other hand, again separated into two divisions, a *lower*, comprising the Daonella beds, with the overlying Tropites beds, and an *upper*, consisting of beds rich in certain brachiopods, with a large Spiriferina, and overlaid by an upper Mergel horizon, bearing bivalves, which is succeeded by the Main Dolomite. Part of the Daonella beds, and particularly their lower layers with true species of Daonella (more especially *Daonella indica*) may perhaps be better assigned to the upper Muschelkalk (Ladinic group of it) as has been done in the foregoing pages for reasons there given; the chief complex of the Daonella beds might more correctly be indicated as the "Horizon of Halobiæ from the group of *Halobia rugosa*," or, as "Horison of Halobia comata, nov. sp.," for the greater number of the species of

Daonella in this group of beds seem to belong actually to the Halobia group just named.

(a) Species from the Lower Division of the upper triassic deposits of the Himálayas.

(a^1) From the Horizon of Halobia comata and the overlying Tropites-beds of Griesbach (Hauerites and Halorites beds of Diener).

SPIRIFERINA SHALSHALENSIS, nov. sp., Pl. IV, Fig. 1.

A Spiriferina with straight, elongated, high, semi-conical, large valve, whose umbo is only slightly incurved, with broad and very high area and proportionally narrow pseudodeltidium. The median sinus of the large valve is moderately broad, but of considerable depth; on each side of it as many as nine ribs may be counted, which become gradually weaker, those nearest the sinus, however, being much elevated and separated by deep intervals. On the rather flat small valve rises a high though not very wide median lobe, which has on each side of it folds seven to eight in number. The shell is thin and thickly dotted over with wart-like elevations. Nothing can be affirmed as to the inner structure of the beak from this single specimen. The shape of this species most clearly recalls the forms of the Hirsuta group (cf. Abhandl. der k. k. geol. Reichsanstalt, XIV., p. 292, Tab. XXXV) but nearly all the species of this group are distinguished by the presence of ribs in the sinus as well as on the lobe. The only exception to this is to be found in *Spiriferina Seebachi*, Proesch.; it is, however, easily differentiated from the form here described by its extraordinarily shallow sinus and its weakly marked ribs. Besides the species of the Hirsuta group there are only left for comparison *Spiriferina manca*, m., and the very similar *Spiriferina Beneckei*, Phil. (not to be confounded with *Spiriferina Peneckei*, m.). Both species of the European Muschelkalk are, however, distinguished by their uncommonly broad sinus, and *Spiriferina manca* also by less numerous and less distinct ribs.

Locality.—A single specimen, collected by Griesbach and recorded as *Spiriferina Lilangensis*, Stol., var., l. c., p. 143. It comes from the Shalshal section near Rimkin Paiar, from Bed 3 of the "Upper Trias Series," or from Bed 125 of the entire succession of beds; it can therefore no longer belong to the Muschelkalk, but certainly to the upper trias, and it must be assigned to the group of the so-called Daonella beds, or more correctly to the horizon of "the species of Halobia of the group of *Halobia rugosa*."

RETZIA SCHWAGERI, Bittn., var. ASIATICA, nov. Pl. VIII, Figs. 1, 2, 3.

Retzia Schwageri is one of the most widely distributed species of Retzia of the Alpine trias, in which it ranges from the Muschelkalk to the Dachsteinkalk (cf. Abhandl. d. geol. Reichsanst., XIV. Bd., p. 295). This type of Retzia is now also found in the trias of the Himálayas, in which it seems frequently to occur just in the horizon between the Muschelkalk and the equivalent of the Dachsteinkalk. The specimens from the so-called "Daonella-beds" will here be next dealt with. The small valve of these forms possesses a median rib, not very strikingly marked, but nevertheless recognizable as such; at each side of the median rib there are four ribs, the outer of which are distinctly curved. The frontal margin is truncated in the middle, a position corresponding to that of the median rib. On the large valve there are, on each side of the median furrow, which is only a little broader and deeper than the lateral furrows, five ribs, between the last of which and the small area there still remains a space without ribs, of slight extent, which corresponds with the little ear on both sides of the umbo of the small valve. All the ribs begin at the umbo, or rather at the beak of the valves. They are narrow and rounded, and the intervals between them flat and of slight depth. The beautifully punctate shell is rather thick and exfoliates so easily that almost all the specimens before me are casts. They are, in the manner peculiar to these species of Retzia, ornamented in a more complicated way than the surface of the shell; the ribs and furrows, namely, are more strongly marked on them, and they stand out more distinctly from one another because true radial ridges occur at the boundaries of the ribs towards the flat intervals, while, at the same time, a fine secondary longitudinal ribbing is seen at the sides of each rib. This ribbing augments towards the margin with the increase of growth, and develops very markedly, especially on the curved outer side of the shorter ribs (which diverge from the median line), and continues from the last traces of the primary ribbing to the little ears of the small valve, as well as the corresponding portions of the large valve. The inner side of the test naturally possesses the same sculpture (cf. Pl. VIII, Fig. 3; here a fragment of the shell from the inner side is rendered on an enlarged scale). The inner side of these species of Retzia thus show, foreshadowed as it were, that complex ornamentation which the latest of the species of Retzia hitherto known, *viz.*, the large *Retzia superba*, Suess, sp. of the Kössen beds, also possesses on the surface of its shell. The beak and area are small, slightly incurved; the opening is terminal.

Though this form stands near the European types of *Retzia Swageri*, especially its upper triassic var. *fastosa*, m., nevertheless it cannot be united therewith without reservation on account of the invariably larger number of its ribs. It is true that the older forms from the so-called "Daonella beds" here first referred to are also, with respect to the ribbing, only very slightly different from the Alpine *Retzia fastosa*, but the form occurring in the younger beds with *Spiriferina Griesbachi*, which cannot possibly be separated from its precursor in the "Daonella beds," is invariably distinguished by the number of ribs from the European *R. fastosa.* It seems to me now more to the purpose to designate the Retzia of the "Daonella beds" as var. *asiatica*, although with respect to the ribbing it begins to be distinguished only very slightly from *R. fastosa*. The consideration of its dimensions makes it especially advisable to separate it from *R. fastosa* of the Alpine Dachsteinkalk which remains much smaller, becoming thereby thicker.

A separation in the European Muschelkalk of *Retzia Schwageri* into a type poor in ribs and another with abundant ribs is already proposed (cf. Abhandl.

der geol. Reichsanst., XIV, p. 21, Tab. 36, Figs. 1—4). New material from the Bakonyerwald has shown me that both types occur together in larger numbers of individuals, so that I should now separate the more numerously ribbed form illustrated in Fig. 3. from the chief form as var. *baconica*. W. Salomon in his description of the Marmolata refers (p. 99) to this more numerously ribbed species, *R. Schwageri*, of the Hungarian Muschelkalk, in establishing his *Retzia Taramellii*, and he is inclined to regard the latter as derived from it. Indeed *R. Taramellii*, Sal., might also belong to the extensive series of forms of *R. Schwageri*. With a further progress in the knowledge of the forms belonging hereto, and their mutual relationships, many a name will become superfluous which is necessary for their understanding to-day.

Locality.—From the so-called "Daonella beds," or more correctly the "horizon with species of Halobia of the group of Halobia rugosa," from two different places: from Lauka encamping ground, figured Pl. VIII, Figs. 2, 3, and from the Bambanag section, Pl. VIII, Fig. 1.

RHYNCHONELLA LAUCANA, nov. sp., Pl. VIII, Figs. 5, 6.

A large smooth Rhynchonella, with deep median sinus on the large valve, and high frontal tongue, to which a narrow median lobe on the small valve corresponds. The surface of the shell is provided with fine though somewhat irregular striæ of growth. The beak is small and is not sufficiently preserved in the two specimens under description; in the one specimen the strong crura are conspicuous in the weathered umbo of the small valve. The shell is thick, especially in the umbonal portion.

Bhychonella Laucana stands extremely near a species of the Hallstatt Limestone. This is the *Rhynchonella regilla* described by me (Abhandl. d. geol. Reichsanst., XIV, p. 226, Tab. XIII, Figs. 23, 24), which belongs probably to the Carnic Hallstatt Limestone. *R. regilla*, however, possesses a considerably higher and somewhat broader frontal tongue, whereby also its outline has been influenced and the shape as a whole has acquired a markedly different habit.

Locality.—Two specimens collected by Diener at Lauka in the upper Girthi valley; from the so-called "Daonella beds," which may be more correctly designated as the "Horizon of the species of Halobia of the group of H. rugosa."

RHYNCHONELLA BAMBANAGENSIS, nov. sp., Pl. VIII, Fig. 4.

A specimen of a Rhynchonella of a broad rounded form, with about fifteen to sixteen ribs, which appear distinctly only at some distance from the umbones. The umbo of the small valve with very indistinct, fine, and close ribbing, somewhat similar to that of the species of so-called Rimosæ. The lateral ribs bend very strongly outwards, the front is unsymmetrical, with a one-sided elevation, oblique and provided with four or five ribs, a number however which cannot be affirmed with certainty, because a sharp lateral demarcation of the frontal elevation is only present on one side. On the other side the lateral ribs are somewhat close-set, and one or other of them is bifurcated. The frontal view (Fig. 4, upper one) is represented a little too symmetrical. The beak of the specimen is broken off and shows internally indistinct dental plates extending to the shell-wall.

There are only a few species of Rhynchonella in the Alpine trias of the vague undefined character here described. Among the specimens with numerous ribs of the variable *R. Concordiæ*, m., of the Salzburg - Dachsteinkalk some are found which are very similar, but the ribs of these Alpine species begin in full strength at the umbones. The greater number of the specimens of *R. Concordiæ* possess much fewer ribs. The latter feature obtains in the single specimen hitherto known of *Rhynchonella hecuba*, m., from the so-called Zlambach beds.

Rhynchonella levantina, m., from the upper trias of Balia in Asia Minor (Jahrb. d. geol. Reichsanst., 1891, p. 107) is on the whole narrower, and the ribs originate in it nearer the umbo.

Locality.—Found by Diener in the Hauerites beds (No. 6) of the Bambanag section (compare his work above cited, p. 25). A form, scarcely differing specifically, also occurs in the younger beds of this section with *Spiriferina Griesbachi* (No. 8), which will be dealt with further on.

HALOBIA FASCIGERA, NOV. sp., Pl. VII., Fig. 15.

Specimens of Halobia in great numbers are also before me from the so-called "Daonella beds" (excluding their lowest division, which has already been referred to as the horizon of *Daonella indica*). They belong for the most part to species from the group of *Halobia fallax* and *Halobia rugosa*; but unfortunately, like all fossils of this group of beds, they leave much to be desired in respect to their preservation, and only a few of them can therefore be taken into account.

To these belong, in the first place, the form represented on Pl VII, Fig. 15, of a species which is not to be found among the species of the Rugosa group hitherto described. Its form is proportionally high, that is, its height is scarcely perceptibly exceeded by its length, and it is thus markedly oblique. The umbonal half of the shell—the figured form is a left valve—is pretty high and regularly inflated, the marginal half (taken in the radial direction), on the other hand, quite flat; at the boundary of these two divisions of the shell lies the remarkable interruption of the striæ of growth, which is developed in all species of the Rugosa group. The umbo is very feebly developed and scarcely projects above the straight hinge-line; the ear, on the other hand, is very wide, raised above the adjacent shell, and consists of a narrow and flat outer division and a radial inner one which is twice as wide and strongly elevated. The radial sculpture, particularly that of the median portion of the shell, begins very near the umbo, so that only a very limited umbonal space remains free from it. The radial furrows are deep and distinct; between the primary ones, which are somewhat close-set (in the central area of the shell in a space of about 10 mm. there being about nine of such primary furrows), finer, but likewise very distinct secondary, and between these again tertiary, furrows are intercalated, so that a bundle-like ribbing arises, quite analogous to that of *Daonella Lommeli*, but closer and less distinctly marked, and confined to the middle of the shell; while, towards the anterior the primary ribs divide once, or only at a great distance from the umbo tertiary furrows also occur. Towards the posterior, however, the whole of the ribbing seems to become more indistinct, and towards the hinge-margin gradually dies out. Near the inner margin of the ear a few finer ribs are crowded together. The complicated division, or bundle-like arrangement of the middle ribs already occurs in the umbonal portion, lying above the larger interruption of growth. The sharp angle caused by the interruption of growth comes out most distinctly in the middle ribs. The ribs are moreover more or less markedly undulating throughout their whole extent, and scarcely decrease in strength towards the pallial margin. The wrinkling of growth is particularly strong on the umbonal part of the shell, but only weakly developed on the flat lower portion of the shell; also the umbonal part of the ear is coarsely wrinkled. *Halobia fascigera* may be sufficiently distinguished from all the species of the Rugosa group hitherto described. Not a single one of these species possesses the distinct bundle-like sculpture of the ribbing, but all those species in which the umbonal part is ribbed show a more or less simple, uniformly strong, radial furrowing, which only in a few forms, *e.g.*, *H. fluxa*, *H. Zitteli*, is as strongly developed as in *H. fascigera*, or perhaps still more strongly so; in the greater number of species, however, it remains much finer. The specific name is taken from the bundle-like ribbing of the form.

Locality.—Collected by Diener in the lower layers of the so-called "Daonella beds," or rather the horizon of Halobia of the Rugosa group, in the Bambanag section of the Girthi Valley. The bed from which the species is derived is indicated as Nos. 1 and 2; this indication corresponds perhaps with the numbers 5*a* and 5*b*, Diener, l. c., p. 24. The form may therefore have its habitat in the deepest layers of this horizon.

HALOBIA COMATA, NOV. sp., Pl. VII., Fig. 13.

A tolerably well-preserved right valve of a form which, though approximately equal in outline, is at once distinguished from *Halobia fascigera* just described by its extremely indistinct, almost obsolete, ribbing. While *H. fascigera* belongs to the most coarsely and distinctly ribbed species of this group, *H. comata* is, in respect of its ribbing, most closely related to *H. rugosa*, it coming in fact so near it that incompletely preserved specimens of the two species may be easily confounded. But the umbonal part of the shell of *H. comata* is not as in *H. rugosa* quite without ribs, though likewise finely ribbed. The ribs of *H. comata* begin already near the umbo. They are close-set, very small, and undulating; a specially marked concentric angle in the ribs, between the umbonal and the pallial portion of the shell does not exist, at least in the specimen under description. Here and there a single rib stands out a little more prominently; at the posterior margin there is an almost smooth narrow space on which the striæ of growth converge more strongly towards the umbo. A similar structure of the posterior hinge-margin moreover occurs in *H. rugosa*, *H. Neumayri*, and other species of this group; it is almost the same as what has been designated as the 'ear' at the anterior hinge-margin of *Daonella Lommeli*. The anterior ear of the specimen of *H. comata* under description is not preserved; only the extreme part of the lower margin of it is still there and their position proves that this species also possessed a very broad anterior ear.

Locality.—In the so-called Daonella beds, or rather the horizon of the species of Halobia of the Rugosa group in the Bambanag section of the Girthi Valley. The bed in which this form occurs is indicated by Diener as No. 4, the species is therefore geologically younger than *H. fascigera*.

The present species seems to occur also farther to the north-west in the Niti region. It will be the subject of further comparison below.

Remarks on Halobia comata.—On the ground of the material being insufficiently preserved, I should not like to separate the Halobia figured on Pl. VII., Fig. 14, from this species for the present. It is a weathered umbonal fragment, with both the valves, of which the two anterior ears are rather well preserved, and though the finer details are, it is true, not recognizable, their great width is remarkable. The umbo is finely ribbed, the ribbing indistinct and nearly obsolete as in *H. comata*. From the specimen of the latter species represented in Fig. 13, Figure 14, could only be distinguished by its more elongated outline and consequently lesser height; but these particular proportions appear to be in no way constant in some species of Halobia, and as, moreover, distortion may have come into play in the present case, I refrain from giving the specimen represented in Figure 14 a special name and unite it as *Halobia* cf. *comata* with the species described above. This specimen is, according to Diener, still younger than the original of Figure 13; it comes from No. 6 of the division of beds of the Bambanag section in the Girthi Valley, which may perhaps be the 'Hauerites beds' at the upper boundary of the so-called 'Daonella beds,' the true beds with species of Halobia of the Rugosa group. Thus we see that in the whole thickness of those 'Daonella beds,' argillaceous for the greater part, species of Halobia of the Rugosa group occur, a circumstance of rather considerable stratigraphical importance, as, in all probability, this horizon, with species of Halobia from the Rugosa group, represents, or at least includes, the lower group of beds, poor in limestone, of the Alpine trias, in which *Halobia rugosa* itself has its habitat, and consequently the Lunz Raibl beds.

There occur, however, in this complex of beds also species of Halobia of other types, which have hitherto been only found in fragments. To them belong the specimen figured on Pl. VII., *viz.*, Fig. 16, a left valve with an unmistakable beginning of an anterior ear, which may however have been flat. The specimen comes from the Shalshal section (upper trias, Bed 8), near Rimkin-Paiar, was collected by Griesbach and referred to as *Daonella Tyrolensis*. As this reference is found in Griesbach, l. c., 143, the specimen may have come from the upper part of the Daonella beds. This form has little in common with *Daonella Tyrolensis*; but it is also decidedly different from *Halobia rarestriata*, Mojs., which must be specially pointed out, because Griesbach records this species also from other places. There may, on the other hand, be a relationship rather to the group of *Daonella* (? Halobia) *styriaca*, Mojs., but the preservation of the specimen is unfortunately not sufficiently perfect to enable one to pursue the inquiry further.

Remarks upon Halobia comata, 2.—A faintly sculptured Halobia, which I cannot distinguish with certainty from *Halobia comata*, but which as far as its state of preservation allows of an examination, is a cast on a slab of black limestone. This was collected by Griesbach north-west of Kiunglung, south-west of the Niti Pass, in the horizon of his 'Daonella beds' (cf. Griesbach, l.c., p. 123). The specimen proves that the species of Halobia of the Rugosa group in this horizon are widely distributed in the trias of the Himálayas.

The *Halobia* cf. *comata* of this compact black limestone of Kiunglung attains considerable dimensions; a second, still larger specimen that probably also belongs here may measure more than 90 mm. in length. Its wide anterior ear is recognizable, while the first-mentioned species shows the slight ribbing of the umbonal part, which distinguishes *Halobia comata* from *H. rugosa.*

From the same specimen of rock comes a small ribbed Lima, which will be described further on. A small Lingula of peculiar outline seems to be more abundant in it, but unfortunately no form suitable for illustration could be freed from the rock.

AVICULA (?) GIRTHIANA, nov. sp. Pl. VII., Figs., 17, 18, 19.

A small Avicula-like form, which deserves mention on account of its good state of preservation. The very small shells are considerably oblique, strongly inflated and provided with prominent, concentric undulations of growth, between which a faint striation of growth is visible. There is scarcely any difference in the amount of inflation of the two valves. The hinge-line, beyond which the beak projects, is short but straight; the angles formed by the junction of the hinge-line and lateral margins are rounded. The anterior ear is not sharply marked off from the rest of the shell, but it is distinctly developed and proportionally large, and separated from the remainder of the shell by its lesser inflation and a perceptible emargination of the anterior margin, to which also a slight curvature of the striæ of growth corresponds. The posterior wing is, on the other hand, only indicated by a slight flattening of the shell along the hinge-margin. I should have taken this Aviculid of so undefined and vague a character for a young form of one of the large species of Halobia occurring in these beds, if it did not possess the rather distinct, proportionally large anterior ear, tolerably sharply marked by the emargination of the anterior border, as this does not to my knowledge exist in any of the young forms of Halobia. One had to consider, in the first place, the species of Halobia of the Rugosa group, not only on account of the smooth shell, but also on account of the occurrence of such species in the 'Daonella beds.' A comparison with well-preserved young forms of the Alpine *Halobia rugosa* has shown that in *Avicula Girthiana* we are not dealing with young specimens of related species of Halobia, as in these the ear is scarcely recognizably indicated, and, above all, does not appear to be separated from the rest of the shell by the emargination of the anterior side.

These young forms of *Halobia rugosa* are, moreover, far less oblique than *Avicula Girthiana.* Young specimens of the Indian species of Halobia of the group of Rugosa might well stand so near Alpine forms related to them that a comparison between these and *A. Girthiana* would give the same result.

Locality.—In the horizon of the species of Halobia of the Rugosa group ('Daonella beds') of the Bambanag section in the Girthi Valley (Beds Nos. 3-5 of Section 2) collected by Diener. In a larger specimen of the black argillaceous limestone this small species is represented by numerous forms with glossy black, sometimes velvety, shell, without being in association with other species.

CASSIANELLA (spec. plur. indet.), Pl. VIII., Figs. 7, 8, 9.

The genus Cassianella, known to be one of the most important typical forms of the Alpine trias, appears to occur, and not rarely, also in the upper trias of the Himálayas, especially in the division of beds dealt with in this chapter, up to the strata with *Spiriferina Griesbachi.* Griesbach refers (l. c., p. 142) to a Cassianella from Bed 22 of the upper trias of Rimkin-Paiar (East), as ? *Opis globata,* Dtm. The specimen is a cast, figured on Pl. VIII, Fig. 9. It extremely resembles in its shape certain of the most abundant species of Cassianella of St. Cassian, especially *C. gryphæata* and *C. tenuistria,* Münst. It shows very distinctly the presence of the single faint radial rib before the commencement of the slope of the posterior side, as found in the typical *C. tenuistria* (cf. Abhandl. der k.k. geol. Reichsanst., Bd. XVIII., Heft 1, p. 58). The state of preservation of the Indian specimen precludes a more minute comparison.

In Diener's collections from the Bambanag section there are also several species of Cassianella in a very imperfect state of preservation, two specimens from which (Pl. VIII., Figs. 7, 8) are figured. They are also for the greater part casts, with only here and there remnants of the shell adhering. The latter is in the form represented in Fig. 7, rather thick, and appears to have only possessed faint striæ of growth remotely placed. The back of the shell is narrow and high, the posterior slope, on the other hand, elongated. The specimen, Fig. 8, seems broader and more regularly rounded, and possesses more crowded striæ of growth. Neither of these specimens allows of the slight keel-like rib of the first-mentioned form being recognized; both show very distinctly the sharp incision which, in the cast, separates the umbo from the plug-shapped infilling of the anterior wing, a very characteristic structure in the genus Cassianella. The three figured specimens seem to represent forms related to three different species, which would point to a rich representation of this genus in the upper trias of the Himálayas.

It is well known that the first Cassianella from the trias of the Himálayas was made known by Gümbel (Sitzungsb. der königl. bayr. Akad. d. Wissensch. 1865, II, p. 361, Fig. 13). This species, *viz., Cassianella grypostoma,* Gümb., which is regarded as coming from the so-called 'Spiti sandstone' and is, therefore, lower triassic, is compared by Gümbel himself with the St. Cassian *C. planidorsata*, and indeed possesses a marked flattening of the back, a character not exhibited by one of the specimens here mentioned, is moreover much less oblique than any of those specimens and belongs, therefore, almost certainly to a different type.

There will further on be named and described another Cassianella which originates in the horizon with *Spiriferina Griesbachi* and represents the type of the ribbed species of Cassianella.

Locality.—In the horizon of the species of Halobia of the Rugosa group (the so-called 'Daonella beds') in the Shalshal Cliff, as well as in the Bambanag section.

LIMA, spec. indet., Pl. VII., Fig. 20.

A small ribbed Lima of a somewhat broad shape, with a steeply sloping anterior and a gradually flattening posterior side. Ribs to the number of about sixteen, more strongly marked anteriorly, gradually dying out posteriorly, moderately wide, flat and separated by intervals of the same width as themselves. The sloping, level, anterior area without ribbing; the anterior ear rudimentary, the posterior ear faintly wing-like, without being distinctly marked off from the shell. The species is probably related to the widely spread Muschelkalk form *Lima striata*, Goldf., which extends upwards into the Ladinic limestone of the Alps (Esino, Marmolata).

Locality.—South-west of the Niti Pass, North-west of Kiunglung, in compact black limestone beds which bear on their surface the above-named *Halobia* cf. *comata* (p. 47), and in the interior of the rock there occur besides the rare Lima more abundant fragments of a small peculiarly shaped Lingula, from which unfortunately no specimen, suitable for description, could be obtained.

LIMA, spec. indet., Pl. VIII., Fig. 11.

A small Lima, whose cast shows 12 or 13 rather high and strong ribs, and whose shell is more inflated than that of the species just mentioned from Kiunglung, while its anterior slope appears less sharply marked off from the ribbed area of the shell. The specimen is moreover much too imperfectly preserved for a more minute description and comparison of it to be given, and it is only mentioned here to show that more or less similar small ribbed species of Lima occur in very different horizons of the upper trias of the Himálayas.

Locality.—In the Halorites (Tropites) beds of the Bambanag section collected by Diener.

LIMA SERRATICOSTA, nov. sp., Pl. VIII., Figs. 12, 13.

This form belongs perhaps rather to Lima than to Pecten. In favour of this view are its oblique shape, the steep slope of one (anterior ?) side, and the apparently slight development of the ears. The proportionately thick shell is raised at intervals so as to form seven high roof-like ribs, on whose blunt edges the striæ of growth, elsewhere very fine and crowded, become elevated into rows of small blunt tubercles which give a serrated appearance to the ribs. The three middle and strongest ribs only possess one row of such serrations on their crests, the weaker ribs, succeeding on each side outwardly, show on the other hand besides the chief row on the crest, one or two weaker rows of a similar kind, which rise constantly on the *outer* side of each rib. The posterior of the three middle ribs also possesses a trace of a similar accessory row of serrations near the lower margin of the shell, and here it also lies on the outward side.

Nothing definite can be affirmed as to the shape of the ears in consequence of their imperfect preservation; the posterior ear appears to be sharply marked off from the shell. The cast of this thick-shelled species is distinguished by the fact that on it (Fig. 13) the ribs stand out much more clearly from the furrows than is the case on the surface of the shell itself.

I know of no species which could be closely compared with this form, which generically remains, it is true, somewhat uncertain. Its striking shape justified, I think, a description of it so far as it was possible to make out.

Locality.—Collected by Diener in the so-called 'Tropites beds' of the Bambanag section (II). An identical, or at least very closely related form seems also to occur in still higher beds, as the cast (Pl. X., Fig. 26) shows. The latter is derived from the so-called 'Corbis-zone' of Griesbach, or Diener's Sagenites beds, succeeding the horizon of *Spiriferina Griesbachi*, likewise from the Bambanag section (II). The typical bivalve of the Sagenites beds occurs, however, also below the beds with *Spiriferina Griesbachi*, as will be shown further on (cf. *Anodontophora Griesbachi*).

(a^3) *From the Horizon of Spiriferina Griesbachi, and the Sagenites beds succeeding them.*

SPIRIFERINA GRIESBACHI, nov. sp., Pl. IX., Figs. 1—13.

Spiriferina Griesbachi, m., Diener, l. c., p. 26.

The most abundant species of the brachiopod-bearing latest horizon of the trias of the Himálayas as yet known may bear the name of Mr. C. L. Griesbach, the Director of the Geological Survey of India, who was the first to assign this form to its stratigraphical horizon, and who already recognised that it differed from *Spiriferina Lilangensis*, Stol., for which reason it was designated by him *S. Lilangensis*, var.

Spiriferina Griesbachi is a large and remarkable Spiriferina with very variable development of the beak and the area of the large valve, distinguished specially by its broad sinus, in which there is a single weak median rib, to which corresponds a median furrow in the small valve, and by which its median lobe is rendered bipartite.

The area, at least in the specimens from the Bambanag section on which our description is based, is mostly very high (Fig. 4), but in the same bed there are also specimens with considerably lower area (Fig. 7). The curvature of the beak above the area is considerable in specimens of the latter kind, while in specimens with very high area the beak is almost straight, and a slight curvature takes place only at the apex. The lateral margins of the area are blunt. On each side of the very broad sinus of the large valve there are from 7 to 10 ribs, which are low and flat and the outermost of which seems more or less to be completely obliterated, so that between the ribs and the margin of the area there remains still a space without ribs, or almost without them.

The lobe of the small valve rises considerably above the lateral parts; its median furrow begins only at a certain distance from the umbo. The shell-structure is a roughly punctate one.

The dental plates are in the interior of the apex of the beak fused as by a callus with the median septum, and only become free further down; they extend to the wall of the shell and reach pretty far down at the outer side of the beak, but not so far as the median septum itself (Fig. 4).

Only one Spiriferina of the trias is known to me, which seems to be closely related to *Spiriferina Griesbachi*, viz., *Spiriferina Moscai*, m., from Balia-Maaden, in Asia Minor (Jahrb. der k. k. Reichsanst., 1892, p. 80, Tab. IV., Fig. 8). Though the specimens of *S. Moscai*, hitherto known, are imperfectly preserved, yet they admit of being distinguished from *S. Griesbachi* by the fact that the sinus is narrower and shallower, and that the median rib lying in it, as well as the lateral ribs, are stronger than in *S. Griesbachi*; and the number of its lateral ribs is also smaller. From the Alpine trias no species is yet known to me which could be compared with these two species of Spiriferina of the Asiatic trias.

Locality of Spiriferina Griesbachi.—In the Bambanag section of the Girthi Valley, near Martoli Encamping Ground, very abundant in Bed No. 8, which was named after this species as the Horizon of *Spiriferina Griesbachi*. Griesbach's Spiriferina Horizon, with Spiriferina Lilangensis, var., is evidently the same horizon.

Remarks on Spiriferina Griesbachi.—Only after I had communicated the remarks on the brachiopods of the horizon of *Spiriferina Griesbachi* to Dr. C. Diener, published in his work, p. 26, my attention was drawn to the two species, *viz.*, *Spirifer tibeticus* and *Spirifer altivagus*, included by F. Stoliczka in his (carboniferous) Kuling Series (Stoliczka, l. c., p. 28, Tab. III., Figs. 1—3). These two species, which were collected by Dr. Gerard in Spiti, can by no means, however, even on the ground of Stoliczka's views, be regarded with certainty as carboniferous forms; it is, moreover, not at all improbable, on account of their close relationship to *Spiriferina Griesbachi*, that they also originate in triassic deposits Stoliczka already knew that his *Spirifer tibeticus* was a Spiriferina, and *Spirifer altivagus* is so closely related to the former species that it is simply to be regarded as a variety of *Spiriferina tibetica*, Stol., sp. These two presumably carboniferous species have been figured again for comparison with *Spiriferina Griesbachi*, on Pl. IX., Figs. 14, 15, 16, and I believe I can affirm with confidence, after careful investigation, that I am unable to find any more essential distinction between them and *Spiriferina Griesbachi* than that the ribbing is somewhat stronger and more sharply marked. The outlines which are partly different, as a comparison of Fig. 4

with Figs. 14 and 15, makes evident, cannot be regarded as distinctive, as they depend upon the varying height of the area or rather upon the degree of incurvature of the beak, and if one compares Figure 4 (*Spiriferina Griesbachi*) with Fig. 16 (*Spiriferina altivaga*), a form with likewise very high area, one will at once appreciate the small value of that distinction. There are, moreover, specimens of *Spiriferina Griesbachi* with low area and stronger incurved beak (Fig. 7) which are scarcely to be distinguished in this respect from *Spiriferina tibetica* (Fig. 14).

Stoliczka also mentions a loose specimen from the neighbourhood of Kibber, in Spiti. This is also before me, but its matrix is not a carboniferous slate as Stoliczka states, but a marly limestone, strongly effervescing with hydrochloric acid, and exactly the same as a large specimen of rock collected by Griesbach on the western slope of the Manirang Pass[1] in Spiti, and which contains numerous specimens of Spiriferina of the same type and in the same state of preservation as the specimen from Kibber. I would therefore regard these two rock-specimens as coming from one and the same bed. The rock-specimen from the Manirang Pass (cf. Griesbach's "Geology of the Central Himalayas," p. 220) was regarded as rhætic, and we are thereby reminded that Griesbach had already considered the Main Dolomite group as rhætic; it bears the museum number H. 13. 86, and is quite filled with a large Spiriferina which, on a cursory comparison, possesses a certain resemblance to the liassic *Rhynchonella austriaca*, Suess, but is in fact completely identical with *Spiriferina tibetica*, Stol., sp. The specimens figured on Pl. IX., Figs. 8—13, were derived from the locality of the Manirang Pass. I cannot of course form an opinion as to the stratigraphical position of this rock-specimen with Spiriferina from the Manirang Pass, probably found loose, but would it not be quite justifiable from all that is known concerning the distribution of the brachiopod horizon of *Spiriferina Stracheyi* to assume that here in the Manirang Pass in Spiti there is nothing more than the exact horizon of *Spiriferina Griesbachi* in the Bambanag section to be dealt with? But before this is decided, before full assurance is reached regarding the horizon and locality of the 'Carboniferous' *Spiriferina tibetica* from Spiti, and the certainly identical rhætic form from the Manirang Pass, and from Kibber, it will always be advisable in any case to separate *Spiriferina tibetica* from *Spiriferina Griesbachi*, however slight the differences between the two forms may appear, considering the material available. Should, however, the specific identity of both be fully established on the strength of their occurrence in the same beds, it would perhaps be advisable to raise the question whether the name *Spiriferina Griesbachi* should not be retained for this species, as it was assigned to a species of which the exact horizon was determined and has even been applied to designate the horizon itself. The forms *Spiriferina tibetica*, and *S altivaga*, Stol., doubtful as to their horizon, might then be united as varieties of *Spiriferina Griesbachi.*

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[1] From the locality Manirang, Spiti, there is also a small specimen of a peculiar tuff-like dark coloured rock, with some imperfectly preserved specimens of a smooth Pecten, which, judging by the structure of its shell, might be identical with *Pecten filosus*, Hauer, of the Alpine Raibl. and Cardita beds (Torer beds, Opponitz beds, at the base of the Main Dolomite).

Spirifera Vihiana, Davidson (Quart. Journ., 1866, Vol. XXII., p. 41, pl. XXII., p. 4), very closely related to *Spiriferina Griesbachi* and *S. tibetica* may also be referred to here; it comes from the vicinity of Vihi in Kashmir, and is regarded as carboniferous. That similar forms already occur in the devonian is shown in Oehlert's work "Fossiles dèvoniens de Santa Lucia (Espagne)" in Bull. Soc. Gèol. de France, 3 sèr., XXIV., 1896, p. 814, Figs. Tab. XXVIII.

RETZIA SCHWAGERI, Bittn., var. Asiatica, nov. Pl X., Figs. 16—20.

A Retzia from the somewhat older horizon of *Halobia comata* has already been mentioned under the above name (see p. 42). *Retzia Schwageri*, var. *Asiatica*, regarded as typical, belongs to the most abundant species of the horizon of *Spiriferina Griesbachi*. It is perhaps, at least in the Bambanag section, more abundant than *Spiriferina Griesbachi* itself, but is less striking on account of its smaller size. I have more than 20 specimens before me which were got from the few fragments of the Spiriferina rock brought home by Diener. They show all stages of growth, and their length varies from 2·5 mm. up to 13 mm., and even more. They are distinguished from the somewhat older form of the 'Daonella beds' and from the *R. fastosa* of the European Dachsteinkalk, by a constantly larger number of ribs, as already mentioned above (p. 43). Already in the smallest individuals five lateral ribs are to be recognised on each side of the small valve, and in larger specimens there are always six present. For the rest they completely agree with the upper triassic forms of this type. Most of the larger forms are of considerable thickness, and they may therefore be regarded as full grown. A certain variability in the outline, characteristic also of this species, is very well shown in the illustrations, Figs. 18, 19, 20. This variability does not overstep certain limits, as it is also known to be the case in other triassic species of this genus. Something has already been said about its relationship with European forms (p. 44).

Locality.—Not rare in the beds with *Spiriferina Griesbachi*, m., of the Bambanag section in the Girthi Valley. Related or identical forms seem to be quite generally distributed in the group of beds, chiefly marly, between the Muschelkalk and the Main Dolomite horizon of the Himálayan trias.

SPIRIGERA DIENERI, nov. sp., Pl. X., Figs. 1—14.

Spirigera Dieneri, nov. sp., Diener, l. c., p. 26.

As a third abundant and characteristic species in the beds with *Spiriferina Griesbachi* may be mentioned *Spirigera Dieneri*, a form which is distinguished by a certain strikingly characteristic habit from the above-mentioned species of Spirigera from the older triassic formation of the Himálayas, which appear so vague and undefined. This form is also before me in the different stages of growth; the smallest forms scarcely measuring 3 mm. in length, while the largest reach a length of more than 15 mm. Even the smallest individuals are very stiking forms with a distinct longitudinal furrow in the middle of the large, as well as in that of the small, valve. Within the space of 5 mm. the median furrow of the small valve dies out, while that of the large valve developes into a median sinus which widens and deepens continuously, and, in the largest specimen finally forms a triangular frontal tongue, deepened in the centre, to which, on the small valve, a median lobe corresponds, so that in these largest forms the large valve retains its original bipartite character, while the small valve gradually assumes a distinct tripartite shape, by which the median furrow of its umbonal portion generally remains quite distinctly preserved. The development of the external form of the shell is thus in *Spirigera Dieneri* very similar to that of *Spirigera eurycolpa*, m., from the Alpine Dachsteinkalk (Abhandl. d. geol. Reichsanst., XIV, p. 273, Pl. XXIX., Figs. 7—14). It is almost superfluous to remark that *Spirigera Dieneri* also possesses a very considerable variability; there being among specimens of equal size, including the most abundant type, strikingly narrow (Fig. 6), as well as strikingly wide forms (Fig. 8). These variations do not however extend to a greater degree than one is accustomed to meet with in related forms (for example in the abundant *Spirifera Strohmayeri*, Suess, of the Noric Hallstatt Limestone; Abhandl. d. geol. Reichsanst., XIV., Pl. XV).

The shell of *Spirigera Dieneri* is rather thin, and most specimens are for the greater part preserved as casts. Only the umbo of the small valves, and the sides of the beak are thicker-shelled. In this respect *S. Dieneri* is thus united with the older *S. Stoliczkai*, with which it has also in common strong dental plates in the beak extending to the shell-wall. *Spirigera Dieneri* also possesses haplospire spiral cones; it consequently belongs to the true Spirigera species. Forms with diplospire structure are not yet known among the few species hitherto described of Spirigera of the Himaláyan trias.

From the above-mentioned *Spirigera eurycolpa*, m., of the European Dachsteinkalk, *Spirigera Dieneri* is distinguished not only by its much smaller size, but also by the quicker disappearance of the median furrow in its small valve with increasing growth; the two species are by no means closely related to each other. The same may be affirmed with regard to *Spirigera pachyrhyncha*, m., of the Hallstatt Limestone, which may, moreover, probably be reckoned as belonging to the diplospire group or sub-genus Pexidella, m. This species is also wanting in the much-deepened sinus of the large valve, and the median lobe of the small valve is only indicated near the front margin, so that the small valve does not appear to have such a distinctly tripartite character as that of *S. Dieneri*. On the other hand *S. Dieneri* seems to approach very closely to the palæozoic forms (carboniferous) of Spirigera of the sub-genus Seminula (*S. subtilita*, Hall, *S. trinuclea*, Hall).

Locality.—Not rare in the horizon of *Spiriferina Griesbachi* in the Bambanag section, near Martoli Encamping Ground in the Girthi Valley.

AMPHICLINA, sp. Pl. X., Fig. 15.

A minute shell which certainly belongs to a species of the genus Amphiclina; it has the undefined form of *A. Lunzensis*, m., or *A. austriaca*, m. It represents, at present, the only form of this genus which is yet known from non-European triassic deposits. I have lately had occasion to describe an Amphiclinodonta from the trias of Balia Maaden in Asia Minor (Jahrb. d. geol. Reichsanst, 1895, p. 252). When one reflects how little we knew, and that not very long ago, about the species of Amphiclina, so generally distributed in the Alpine trias (cf. Abhandl. d. geol. Reichsanst., Band XIV), one may be allowed, at the first discovery of an Amphiclina in the upper trias of the Himálayas, to indulge in the hope that these insignificant but interesting brachiopods may also be found there more abundantly.

Locality.—In the beds with *Spiriferina Griesbachi* in the Bambanag section of the Girthi Valley.

RHYNCHONELLA BAMBANAGENSIS, nov. sp., Pl. IX., Fig 18.

A Rhynchonella from the Hauerites beds of the Bambanag section has already been described above as *Rhynchonella Bambanagensis,* (p. 44). A form closely related to it, which may well be regarded as specifically identical, taking into account the poorness of the material at hand, is represented by three specimens, also from the somewhat younger beds with *Spiriferina Griesbachi* in the Bambanag section. The specimen figured (Pl. IX., Fig. 18) is distinguished from the single form from the Hauerites beds (Pl. VIII., Fig. 4) only by a ribbing beginning somewhat nearer the umbones, and by a symmetrical frontal area, to whose elevated part the five middle ones of the 14 to 16 ribs of the small valve belong.

In this specimen, however, one side (the right side), as in the specimen from the Hauerites beds, is in the front view, so to speak, somewhat aborted, and here, as there, a rib is inserted at a distance from the umbo on this side. One of the two other specimens from the beds of *Spiriferina Griesbachi* also possesses an asymmetrical frontal area exactly like the figured specimen from the Hauerites beds. The last specimen is again a symmetrical one, with six ribs in the middle of the elevated frontal area. The beak is a short, pointed, Rhynchonella beak, with delicate dental plates, extending to the wall of the shell. As to the mutual relationship of the species, mention has already been made (p. 45). Forms, also symmetrical, of *Rhynchonella levantina,* m., there referred to, are distinguished from the Indian species by considerably smaller width. The symmetrical form of *Rhynchonella Bambanagensis,* on the other hand, vividly recalls *Rhynchonella Mentzeli* of the Alpine Muschelkalk, which however, shows a stronger ribbing arising from the umbones themselves.

Locality.—In the beds with *Spiriferina Griesbachi* in the Bambanag section of the Girthi Valley.

RHYNCHONELLA MARTOLIANA, nov. sp., Pl. IX., Fig. 17.

A single specimen of a Rhynchonella, unfortunately badly preserved, of the remarkable winged type of the Alpine Muschelkalk species, *Rhynchonella vivida,* m., and *R. volitans,* m. (Abhandl. d. k. k. geol. Reichsanst., XIV., pp. 10, 47, Pl. 31, 32).

The large valve of this species possesses two middle ribs and four or five lateral ribs which are very fine at the apex of the beak whence they arise. The median lobe of the small valve must therefore have had three ribs. The middle ribs as well as the lateral ones originate at the beak. They are not, so to speak, excluded from the back of the beak by the union of the inner lateral ribs above the median sinus. In connection with this the median sinus of the large valve in *R. Martoliana* is only indicated near the umbo by a slight depression, and the profile contour runs from the beak up to this in a strongly convex arch, while in the Muschelkalk species mentioned above the median depression of the large valve begins quite near the beak. This dfference is not clearly enough defined in the illustration (Fig. 17). The lateral parts of the valve are in the same manner widened into wing-like forms, and thinned out, as in *Rhynchonella volitans.* The beak is, in connection with the outer contour of its median line, somewhat curved forward. The present description of this single fragment suffices at the same time to permit of its dissimilarity to the Alpine Muschelkalk species with which it has been compared coming into prominence. A species of this type is not yet known to me from the upper Alpine trias.

Locality.—In the beds with *Spiriferina Griesbachi* of the Bambanag section, near the Martoli Meadows in the Girthi Valley.

AULACOTHYRIS JOHARENSIS, nov. sp., Pl. IX., Figs. 19, 20.

An *Aulacothyris Nilangensis* of a very indefinite shape, from the horizon of *Daonella indica,* has been described above (p. 30). In the beds with *Spiriferina Griesbachi* a very similar species occurs, which can only be distinguished from the older species by unimportant features.

The oval shell of this younger species, inclined to be somewhat pentagonal in shape, seems to possess a finely punctate shell-structure, and while the median septum of *Aulacothyris Nilangensis* appears as a strong, thick, but somewhat indistinctly defined streak, in *Aulacothyris Joharensis* it is, for an equal length, a very fine but extremely distinct, dark line. This septum, as well as the slightly divergent dental plates in the beak extending to the shell-wall, indicate also that this form is, in spite of its little characteristic shape, a true Aulacothyris. Its beak is small, depressed, and only slightly hollowed out under its rounded lateral margins. The surface is smooth; coarse concentric striæ of growth, which occur in nearly all specimens of *Aulacothyris Nilangensis* are wanting in this species. Traces of very fine striæ of growth appear only here and there (these have been represented a little too coarse in the illustration). Otherwise this species stands, as already stated, very near the older *Aulacothyris Nilangensis,* and is distinguished also in a similar manner to this from the known species of the Alpine trias.

Locality.—In a few specimens from the beds with *Spiriferina Griesbachi* of the Bambanag section, near Martoli Encamping Ground in the Girthi Valley.

CASSIANELLA PULCHELLA, nov. sp., Pl. VIII., Fig. 10.

A very elegant small Cassianella of a broad shape and with a moderately inflated left valve, the only valve known. It belongs to the forms with fine radial ribbing. The central inflation of the shell is broadly-rounded and bears posteriorly, in the same position as in the St. Cassain species *C. tenuistria*, a single remarkable slender radial rib, a kind of keel. Moreover, the entire central inflation in front of this keel, as also the slope of the shell behind the keel up to the saddle-like depression in front of the weakly-developed posterior wing, is covered with numerous very fine radial ribs, which are about 15 or more in number, in front of the keel, and about the same number behind the keel. The small ribs situated in front of the keel are very feebly developed and differ little from each other in strength; in some specimens the most anterior group of these is a little more strongly raised, while the succeeding ones become weaker, so that here and there in the middle of the shell, in the front of the keel-like rib, a very slight radial depression is formed, which becomes only preceptible through the projection of the keel-like rib. The small ribs behind the latter are more crowded and somewhat stronger than those in front of this principal rib, especially the ribs nearest to the keel being generally the strongest in the whole shell, though they do not attain to the strength of the keel-like rib. In a few individuals a differentiation makes itself apparent among them, for those lying immediately above the posterior slope appear the strongest.

In the best preserved specimens three weak ribs succeed behind the keel, and after these two remarkably strong ones, which enclose a thin intervening rib and come next to the keel in point of strength. This differentiation of the posterior ribs is less striking in the remaining specimens before me, but it always exists. The posterior wing is only free from ribs at its narrow border, while on the more strongly defined anterior wing, which, however, is not well preserved in any of the specimens, the striation of growth seems to predominate over the ribbing. It is true the striation of growth is, over the rest of the shell, everywhere distinct, but not so strongly developed as to produce an actual reticulation of the surface. The radial striation, however weak it is in itself, predominates. One could most properly speak of a net-like sculpture on this posterior slope of the shell, where the striation of growth also becomes somewhat stronger. *Cassianella pulchella* is evidently a species closely related to *Cassianella speciosa*, Mer., from the Kössen beds of the Alps, and may perhaps be regarded as the precursor of that species, which scarcely possesses nearer relationship among the older Alpine species of Cassianella. But, apart from the very different size of the two species, the keel-like rib would never stand out in so remarkable a manner in *C. speciosa;* moreover, the posterior wing of the Kössen species is almost quite free from ribs.

Locality.—In the beds with *Spiriferina Griesbachi* of the Bambanag section in the Girthi Valley. From the rock specimens brought home by Diener, four specimens, left valves throughout, could be obtained. Right valves even of the most abundant species of Cassianella of the Alpine trias are, as is known, very rarely found.

LIMA CUMAUNICA, nov. sp., Pl. X., Fig. 25.

A small neat species, narrower and perhaps also a little more oblique than the two forms illustrated on Pl. VII., Fig. 20 and Pl. VIII., Fig. 11, derived from older beds. The surface bears about 15 ribs, which do not extend to the anterior, steeply sloping somewhat hollowed portion of the shell, while towards the posterior they die out without previously becoming much weaker and leave a narrow space along the hinge-margin free. They are simple, broadly rounded or flattened, not roof-shaped, separated by intervals which are narrower than the ribs themselves. The striæ of growth are scarcely perceptible. The anterior ear is distinctly developed, while the posterior forms a kind of wing which is almost as steeply sloping as the anterior part of the shell.

This small species seems also to be a straggler of the Striata-group of the Muschelkalk; it is distinguished from certain forms of the Alpine trias (*e.g.*, *L. Telleri*, m., from the Esino Limestone, *L. paulula* from the Cardita beds) by its narrower shape as well as by its less numerous ribs, which quickly die out towards the posterior part of the shell.

Locality.—From the beds with *Spiriferina Griesbachi* of the Bambanag section in the Girthi valley, in two tolerably well preserved valves.

PECTEN BIFORMATUS, nov. sp., Pl. X., Figs. 23, 24.

A small Pecten with quite peculiar sculpture. The surface is ribbed, the ribs are arranged in bundles, that is they arise out of a three- to four-fold division, from a few (9-10) principal ribs, so that at the margin of the valves 30 ribs can be counted, of which the middle ones are mostly arranged regularly in bundles of four, the lateral ones, however, being less regularly grouped. The posterior part of the shell, the steep slope towards the scarcely distinctly defined posterior ear, is differently ornamented, for from the last strong radial rib radiates a weak ribbing or striation towards the posterior margin in the manner of a quill with feathers on one side. This ribbing varies in strength in different individuals, in some it being only very faint, indicated as a kind of irregular wrinkling, in others more regular, stronger, and even deepening towards the margin. Here and there it is even interrupted by traces of a radial furrowing. The byssal ear of the right valves is likewise radially ribbed. The above remarks are applicable in the first place to the right valve. The left valve forms in its sculpture the 'negative,' so to speak, of the right valve, for, while in the right valve the furrowing dominates everything, the ribs represent the more conspicuous element in the left. There are thus in the right valve bundles of ribs between the strong furrows; in the left valve, however, between the principal ribs there are furrows subdivided by secondary ribs. The sculpture of the right valve appears therefore deepened or grooved, that of the left valve raised. The entire inflation of the left valve is also somewhat stronger than that of the right valve, so that in this species the lower and upper valves are markedly different. This distinction however is unfortunately not sufficiently expressed in the illustration of this species, the figure of the left valve (24) more specially leaving much to be desired. The sculpture of the left valve resembles indeed very closely that of the left valve of *Pecten interruptus* figured beside it (Fig. 22). The strong radial ribbing of the anterior ear is also not sufficiently indicated in Fig. 24. The striæ of growth in *Pecten biformatus* are only slightly marked.

I know of no species which could be compared in the peculiar sculpture of the shell with the form here described, which seems only to attain a very small size.

Locality.—Apparently not rare in the beds with *Spiriferina Griesbachi* of the Bambanag section, for seven, mostly fragmentary separate valves, among which both valves are represented, were obtained from the rock-specimens brought home by Diener.

PECTEN INTERRUPTUS, nov. sp., Pl. X., Fig. 22.

With *Pecten biformatus* occurs a second larger species of Pecten, of which, however, only a single partially preserved valve (apparently the left) is available, which possesses a ribbing quite similar to that of the left valve of *P. biformatus*, that is, a number of slender principal ribs, in the intervals of which several systems of finer accessory ribs are inserted ; the fine transverse striation, however, of the posterior portion of the shell is wanting in this larger species, and also the two ears are almost equally strongly defined, and apparently smooth or without ribs. The place where the shell merges into the ears is marked on each side by narrow but steep, almost furrow-like, deepened slopes. The figured form possesses a striking interruption of growth in the middle of the shell, beyond which the ribbing certainly continues, but is considerably weaker ; the contrast, however, is too strongly expressed in the illustration.

The species recalls *Pecten Landranus*, m., from the Alpine trias (Abhandl. d. geol. Reichsanst., XVIII., Heft I., p. 166, Pl. 19, Fig. 21) without, however, being identical with it.

Locality.—Collected by Diener in the beds with *Spiriferina Griesbachi* in the Bambanag section.

ANODONTOPHORA[1] GRIESBACHI, nov. sp., Pl. VIII., Figs. 14, 15, 16.

This shell, very similar in fact to the greatly lengthened form of the genus Gonodon,[2] Schafh. (*Schafhautlia*, Cossm., Corbis, auct.), widely distributed in the Alpine triassic deposits, proves, by its thin shell and further on account of the want of teeth, the non-existence of a pallial sinus, and its non-gaping shell, as most probably belonging to that group of forms to which has been applied hitherto the generic name Anoplophora, Sandb., which has however been recently replaced by M. Cossmann by the term Anodontophora.

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[1] Anodontophora is proposed by M. Cossmann in his Revue critique de Paléozoologie, Nr. 2, Avril, 1897, as a substitute for Sandberger's generic name Anoplophora, already long preoccupied.

[2] Also Gonodon, Schafh., belongs, according to M. Cossmann, to preoccupied names. He proposes, as cited above, the generic term Schafhautlia.

This tolerably large bivalve is before me both as shells and as casts, and appears not to be rare in the uppermost marly layers of the series of beds devoloped between the Muschelkalk and the Main Dolomite, which were therefore formerly designated by Griesbach as the Corbis beds, because the form was first determined as *Corbis Mellingii*, Hauer, var., which seems to be very intelligible from what has just been said. Other specimens from Griesbach's collections bear, however, the designation 'Anoplophora Fassænsis, Wissm., spec.,' which comes already very near the true relationship, for among the species of Anodontophora (Anoplophora) of the European trias this very species stands doubtless nearest to the species under description. According to Dr. Diener's collections *A. Griesbachi* occurs also already lower down in the 'Tropites beds,' and seems also not to be absent in the beds with *Spiriferina Griesbachi*.

The specimens from the black limestones of the 'Tropites beds' are preserved with their test (Figs. 14, 15.). This is very thin in proportion to the size of the shell, and covered with numerous fine and distinct striæ of growth, which become crowded and stronger towards the pallial margin, and are sometimes accompanied by a few stronger interruptions of growth. A radial sculpture does not exist. The outline, a little sub-angular, is very well rendered in the illustrations; the umbo projects pretty considerably, without being particularly strong; it is only shifted from the middle towards the anterior, or is almost medianly situated; its incurvature towards the anterior is inconsiderable; a distinctly defined lunule is wanting. The umbones might touch one another, as there remains only a very slight interval between them in the casts. The test is, moreover, only thin near the umbones, and a slight filing (Fig. 15) was sufficient to prove that a strong hinge-plate with tooth structure did not exist.

The smooth casts of this species from the marly layers of the younger Sagenites beds (Fig. 16), which, towards the pallial margin, mostly show some strong concentric undulations, also prove the non-existence of a hinge and also furnish evidence that the shell nowhere gaped. The muscular impressions are tolerably distinct for the thin shell; a pallial sinus is not perceptible.

As already mentioned, the lower triassic *Anodontophora* (*Anoplophora*) *Fassænsis*, Wissm., sp., is the only species with which *Anodontophora Griesbachi* shows any great resemblance, but it must here be pointed out that the lower triassic species of C. W. Gümbel is also recorded and figured from Spiti.

Locality of Anodontophora Griesbachi.—Several specimens collected by Diener from the 'Tropites beds' of the Bambanag section, besides *Lima serraticosta*, described above.

An unquestionable specimen in Diener's collections is designated as also being derived from the 'Brachiopod beds' (*i.e.*, the beds with *Spiriferina Griesbachi*) of the Shalshal section.

Most abundantly perhaps in Diener's still younger 'Sagenites beds,' in the section of the Shalshal Cliffs, where this species was first found by Griesbach. It also possesses a certain vertical distribution in the upper layers of the marly series of beds among the Main Dolomite equivalents. This distribution seems also to be common to several other species of bivalves and brachiopods (e.g., *Lima Serraticosta, Retzia asiatica, Rhynchonella Bambanagensis*), judging by their association.

Remarks.—The few other bivalves occurring in the Sagenites beds, besides the above (a smooth Pecten, a finely ribbed Lima, etc.,) are represented by specimens so imperfectly preserved that we must abstain from a closer inquiry of them.

(b) *Species from the Upper Division of the upper triassic Deposits of the Himálayas (from the Dolomites and Megalodonta-bearing Limestones.)*

MEGALODON CULTRIDENS, nov. sp., Pl. XI., Fig. 1.

Among the few species of Megalodon lying before me from the uppermost trias of the Himálayas there is one specimen especially noteworthy; it is for the most part a cast with the umbo of the right valve particularly well-preserved. Parts of the umbones, together with the very thick-shelled portions, lying in front of and between the umbones, are also present as test. As the rock, a gray friable dolomite, was very easily removed from the lunular cavity, and thereby it was seen that the fragments of the two valves were separated by a layer of rock penetrating between them, an attempt was made to isolate the two hinges and this succeeded surprisingly well. It is true that the points and edges of the hinge-teeth on the right side remained adherent to the rock of the opposite side, and on account of their brittle, crystalline condition could not be freed from it, but after they had been completely removed a plaster cast of the right hinge was taken from the mould thus obtained. The exposure of the hinge of the left valve, hidden by a thin dolomite coating, was then made, and its uncommonly high and acute teeth were found to be preserved in the most complete manner.

The teeth of the left valve are three in number. They run almost parallel to one another as remarkably high and acute ridges (Fig. 1 c (left) 1 d), which leave very deep furrows between them. The two anterior teeth (Fig. 1 d is viewed from the lunule) are almost equally high, and stand near each other, while the hindmost tooth, which is at the same time the lowest and shortest, leaves a larger space between itself and the preceding one. The edges of these hinge-teeth are sharp, almost cutting; their greatest height is inclined towards the umbo, and from thence they rapidly slope towards the anterior, that is, the upper hinge-contour; the foremost is bent into an angle at its highest point with a tendency of its edge to become double. All the three teeth agree in being gradually curved in their course outwards and towards the anterior. The posteriorly lying portion of the thick but narrow hinge-plate, which is remarkably extended in the direction of the height (it—the hinge-plate—is perfectly preserved in the region of the teeth, also in its inner side), is almost completely level, and only towards its anterior margin some fold-like indistinct elevations are visible which run almost parallel to the upper, anterior parts of the dentition. Immediately backwards from the hinder hinge-tooth runs a flat furrow which cannot be regarded as a tooth-groove, as in the right hinge scarcely any perceptible ridge corresponds to it, so that here the groove for the third, left tooth, is actually hollowed out of the hinge-plate. In front of the third tooth of the left valve there lies a very large, wide and deep tooth-groove for the hindmost tooth of the right valve, whose point inserts itself immediately in front of the point of the third left tooth, into the deepest cavity of this large tooth-groove (in a position which is faithfully rendered in the illustration), while the groove itself, gradually flattening, reaches the anterior margin of the hinge-plate. In the lower, that is, posterior part of this groove, which likewise becomes shallower and at the same time narrower, indistinct secondary ridges are perceptible at its base. The grooving between the two anterior teeth of the left valve, however narrow and deep it may appear in consequence of the height of these teeth, does not cut with its base into the body of the hinge-plate itself, as the posterior tooth-groove does. It is only the case again with the anterior hinge-groove, lying in front of the foremost tooth. It is at least as deep as the posterior groove, but it could not be completely laid bare on account of the very brittle condition of the shell at this place, if the specimen had to be preserved.

We have thus to indicate as elements of the left valve, three teeth and a groove lying in *front* of each tooth; the middle one of these grooves, which is hollowed out between the two narrow and high anterior teeth, does not sink into the mass of the hinge-plate, as is the case with the anterior and posterior tooth-grooves. To these two deep or principal tooth-grooves of the left valve correspond the two chief teeth of the right valve, which are much less trenchant, acute and high, but are broader and more massively-developed than those of the left valve, and which leave between them an enormously wide and deeply hollowed-out space, which represents the common hinge-groove for the two anterior knife-like teeth of the left valve, which in a certain degree fit, as a double-tooth cleft by a median groove, into this wide cavity, in which, besides a great number of secondary tooth-ridges, those deepest hollows, which correspond to the highest points of the teeth on the left side, are very distinctly marked. These conditions are very correctly rendered in the drawing. To the two anterior sharp tooth-ridges, or knife-like teeth of the left valve, thus corresponds actually a very large common groove, in the hinge of the right valve. As a sub-division occurs in this groove through the rising of low secondary tooth-ledges, so the posterior tooth of the right valve divides towards the inside, and the ridge of the anterior tooth of this valve gives off (towards the anterior and below) to distinct, lower, accessory ridges. Through the tendency of the hinge-teeth to cleave and sub-divide, the development of the two narrow and sharp knife-like teeth of the left valve is perhaps to be explained in this species. The furrow between these two teeth, however narrow and deep it is, nevertheless does not cut into the body of the hinge-plate, as a true hinge-groove ought to, and to which no real hinge-tooth of the right valve corresponds, while the two knife-like teeth separated by it only possess a common hinge-groove in the right valve. To this wide and deep tooth-groove an enormous hinge-tooth of the left valve ought to correspond; instead of this the two anterior knife-like teeth appear, which by a great economy of shell-material might perhaps perform the same service even in a superior degree.

The question now arises whether this unusual hinge-structure occurring in

Megalodon cultridens can be brought into harmony with that of the remaining species of Megalodon known, in the first place, with the upper triassic species of the Alps. This question can be immediately answered in the affirmative on the basis of comparison with the original specimens of the south Alpine forms, viz., *Megalodon Tofanæ*, and *M. Damesi*, described by R. Hœrnes (Denkschrift. der Wiener kais. Akad. d. Wissensch., 40 Band, 1880).

The agreement of the hinge-elements in these south Alpine species of Megalodon with those of *M. cultridens* is, in spite of their very different appearance at first sight, very complete, so that there can be no doubt as to the perfect analogy of the structure of the hinge in all these species. A comparison may especially be made with the illustrations of R. Hœrnes (Tab. II., Fig. 2 d, e; Tab. III, Fig. 1a, b; 2a, b). These south Alpine specimens show the following hinge-structure. In the left valve a posterior, rather feebly developed hinge-tooth, to which a posterior groove, only slightly excavated, corresponds in the right valve; in front in the left valve a deep and rather wide groove for the strong posterior tooth of the right valve seems to be often longitudinally furrowed in the centre. In front of this principal tooth of the right valve lies a remarkable tooth-groove of extraordinary breadth, which is very characteristic, especially in the specimen, Tab. II., Fig. 2e. To this groove corresponds in the left valve the entire hinge-area between the two tooth-grooves of this valve, which area consists in several forms of a distinct posterior tooth ledge and of an anterior tooth protuberance, which are separated from each other by a furrow which does not cut into the body of the hinge-plate. R. Hœrnes only takes the anterior protuberance for a hinge-tooth; in his original figures (Tab. II., Fig. 2, and Tab. III., Fig. 3) the posterior ledge of this hinge-area is, however, as strongly raised, or perhaps still more strongly (III., 3) raised than the posterior hinge-tooth of the same valve; this may, therefore, in connection with the tooth protuberance lying before it, certainly be regarded as a double tooth, or more correctly as a bifid tooth, which, from its position, completely corresponds to the two knife-like teeth of the left valve of *Megalodon cultridens* and fits exactly like this into a common large tooth-groove of the right valve. In front of this anterior tooth-structure of the left valve there is besides the anterior tooth-groove of this valve, which is destined to receive the anterior strong tooth protuberance of the right valve. The similarity of the hinge-formation between *Megalodon Tofanæ*, and *Megalodon Damesi*, R. Hœrn., on the one hand and *Megalodon cultridens*, nov. sp., on the other, is therefore so far-reaching that their differences must be confined to the more or less strong developement of the separate hinge-elements. These forms, it is true, represent extremes in this respect, for the tooth-structure in the two Alpine species, compared with that of the Asiatic form, appears actually as if stunted in growth. The hinge-formula of these species of Megalodon would, therefore, be the following :—

$$\frac{\text{L}:\ 10\hat{1}0,}{\text{R}:\ 0101}$$

from which it is to be remarked that the compound tooth $\hat{1}$ represents a type other than the cleft tooth $\hat{1}$ of Trigonia, Mactra, and others, and would, therefore, be better indicated by a different sign, as perhaps ï. The anterior muscular impression lies also in *Megalodon cultridens* in a deep and narrow indentation which separates the hinge-plate from the anterior border of the shell. The lunule in front of the umbones is only slightly excavated, and not very distinctly bordered towards the outside by a slight radial furrow. The ligamental area between the umbo and the hinge-plate is distinctly developed. The test at the umbo and hinge-areas is very thick, as is illustrated in Fig I b, which represents the right valve from the exterior with the inner rock wedge of the infilling of the umbo. The interior of the umbo possesses several ridges and furrows, which run far down from the apex (Figs. 1, 1a, 1b). These are wanting in the cast of *Megalodon Tofanæ* figured by R. Hœrnes (Tab. II., Fig. 1), except the furrow lying far backwards at the outer side, becoming very strong below, which is present in that south Alpine specimen. The striation of growth on the outer side is fine and crowded, arranged in irregularly distributed, concentric swellings; it runs uninterruptedly through the slight radial furrow in front of the lunule, scarcely deflected, into the lunular and ligamental area. The latter is separated by a perceptible ridge from the area behind the umbones, which area is again bordered by a sharper angular ridge of the shell, upwards and outwards. The lower portions of the shell are not present, but Fig. 1 may represent their outline (in the cast) with approximate correctness. In specimens with the test the thick-shelled umbones would almost or completely touch one another. The species, on account of its hinge-structure, is not to be united with any of the hitherto-known species of Megalodon.

Locality.—The only specimen hitherto known comes evidently from F. Stoliczka's collections; the vicinity of Lingti Sumdo (Tibet ?) is given as the locality.

MEGALODON LADAKHENSIS, nov. sp., Pl. XII., Fig. 2.

Megalodon cf. *gryphoides*, Gumb., R. Lydekker, Mem. Geol. Survey of India, Vol. XXII., 1883, p. 164, Pl. IV., Figs. 1—4.

As *Megalodon* cf. *gryphoides*, Gumb., R. Lydekker has already figured a form of a Megalodon not very well preserved, which is distinguished from all species yet known by the striking breadth of the umbonal half, looked at in profile (cf. Pl. XII., fig. 2a). The specimen is slightly inequivalve, the left valve perceptibly larger than the right one; the umbo strongly incurved, lying far towards the anterior; the lunule in front of the umbo small, indistinctly defined, but deeply excavated; the area behind the umbones very large, forming a deep re-entering angle which is almost a right angle. The ligamental groove seems to have been large.

This form, with all allowance for its bad condition is not to be united with any species as yet known. It is especially to be noted that there is no species known whose umbonal half would widen so unusully quickly, a circumstance which gives a very extraordinary outline to the shell. To this must be added the abnormally large and deep area as a second striking feature, which, combined with the one first mentioned, sharply separates the Asiatic form from *Megalodon gryphoides*, Gumb., compared with it. Forms of *Megalodon triqueter*, auct., with broad umbones might rather be compared, but in these also the contour of the lateral view differs very much, and the area is only very slightly excavated. In the latter respect *Megalodon scutatus*, Schafh., and certain specimens of the South Alpine forms, described by R. Hœrnes, stand nearer, but these forms do not even approximately reach the breadth of the upper half of the shell, which altogether possesses a more or less triangular lateral outline. The almost four-sided, stumpy shape of the lateral view of the Asiatic form distinguishes it best from all species of this genus hitherto described.

Locality.—According to Lydekker from a dark limestone from Shargol, in Ladakh. Stoliczka records *Megalodon triqueter* from Spiti and Rupshu in his well-known work, p. 64. Nothing of this species is to be found in the material which has come into my hands. As *Dicerocardium Himalayense*, Stol., next to be dealt with, bears the Museum number $\frac{H\ 47}{471}$, and the above described *Megalodon Ladakhensis*, on the other hand, the number $\frac{H\ 47}{472}$, it seems as if this Megalodon was likewise found by Stoliczka. It is perhaps identical with a specimen mentioned by Stoliczka from the Para Valley.

DICEROCARDIUM HIMALAYENSE, Stol., Pl. XII., Fig. 1.

Dicerocardium Himalayense, Stol., l. c., p. 63, Pl. VII.

This species has already been described and very well figured by Stoliczka. He has in one respect succeeded even better in the illustration than is the case with the one here given from the same specimen, for it represents the roughness of the shell surface more distinctly, while the present illustration appears much too smooth and polished. On the other hand, the front view (Fig. 1) in Stoliczka makes the roof like blunt back, which runs from umbo to umbo in an arch across the anterior sides so little conspicuous, that this view could as readily be taken for the back view but for the striation of growth being more distinctly represented. This anterior ridge, running from umbo to umbo, is in *Dicerocardium Himalayense* not developed as an actual inflation in the manner that it is in the two closely related Alpine species, *Dicerocardium Jani* and *D. Curionii*, Stopp. It is very strongly marked in these two species, specially in *D. Curionii*, which is otherwise in its outline nearer to the Indian species, as pointed out by Stoliczka. This anterior ridge gets stronger at the two umbones also in *Dicerocardium Himalayense*, and the bundle-like striation of growth crossing over this ridge rises upon it into separate strong knobs. The section of the broken-off umbo (Fig. 1d) shows best the enormous thickness of the hinge-side of the umbo.

Locality.—According to Stoliczka, east of the village of Chiote in North-western Spiti, from the so-called Para Limestone. Similar forms, among them perhaps specifically different ones, are according to Stoliczka extremely abundant in this horizon through the whole of north Spiti and south Rupshu.

IV.—APPENDIX : SPECIES FROM BEDS THE AGE OF WHICH IS NOT PRECISELY KNOWN.

MYOPHORIA, ex. aff. OVATÆ, Goldf., Pl. I., Figs. 25—29.

Deposits having a facies of the Alpine Werfen slates are yet unknown from the southern chain of the Himálayas. Long ago (Sitzungsb. der Münchener Akad. d. Wissensch., 1865, II., I., p. 348) Gümbel, on the other hand, from the material brought home by the brothers Schlagintweit, made probable, on petrographical grounds, the occurrence of characteristic Werfen beds in Spiti (Tibet). A small number of species from the sandstone of Balamsali, near Dankhar, have been described and figured by him. Perhaps to this, or to a related horizon, belongs a rock of a peculiar impure calcareo-arenaceous character, that is before me in several fragments, containing bivalves contorted in different directions, and coming from the Dras Valley in Kashmir. It is evidently the same occurrence which Stoliczka mentions in Memoirs, G. S. I., V., p. 349, and from which he names *Megalodon columbella*, Hœrn. The original label of the locality has this designation, but only indicates the rock briefly as 'Trias.' The bivalves contained in it are, however, not Megalodon, but Myophoria from the Group of *Myophoria ovata*, Goldf., which in the Alpine trias, especially in the lower horizons, abound in the Werfen slates. The exposure of the hinge hardly allows any doubt as to their generic position. They are thick-shelled forms, of considerable size, with a strong keel on the posterior side, but so much distorted throughout in the different directions that a correct determination of the original outline is difficult. Specimens like those represented in Fig. 25, or Fig. 29, may come nearest to the original form. The surface of the shell is smooth, its substance dark-coloured. The hinge was exposed on several left valves, and in spite of the distortion, admits of the Myophoria hinge being recognised. The large triangular tooth somewhat emarginate, seems to lie a little more towards the anterior than is usual ; in consequence of this the principal groove in front of it is more weakly developed, and the groove behind it more strongly so than usual, the anterior tooth being only slightly indicated but recognisable. Strong, almost tooth-like, is the ligamental support (Fig. 29*a*). In a second much-rolled fragment of an umbo (Fig. 28), only the posterior tooth-groove is distinct, the anterior only very slightly indicated (quite omitted in the illustration). A hinge of the right valve was also afterwards exposed ; it shows a well developed posterior rounded tooth, and a less distinct anterior conical tooth, between these two lying the deep groove for the principal tooth of the left valve. From these considerations it appears to me that the connection of this species with the Group of *Myophoria ovata*, Goldf., can scarcely be doubted, although on account of its bad state of preservation the species cannot be specifically united with any of the known species ; it may in fact even be new.

There is also from the same rock a fragment of a ribbed shell that might possibly be referred to a ribbed Myophoria.

RHYNCHONELLA MIDDLEMISSII, nov. sp., Pl. VI., Fig. 21.

A single specimen of a small almost smooth Rhynchonella of a rather broad shape, with slightly folded margin. The large valve is somewhat more strongly inflated than the small one, and drawn out at the margin to a very short but broad frontal tongue, which possesses three very slightly indicated folds ; and stands out from the lateral lines of junction of the valves through the medium of a somewhat stronger bend ; two or three slight folds of the lateral lines of junction succeed on each side of it ; all of them reach only a little distance on the surface of the valves, that is, they only begin very near the margin. The beak is pointed, its lateral margins are rather sharp, and a little hollowed out, without, however, forming the ' ears ' or areas of Halorella. From the umbo of the small valve runs a slightly deepened median furrow (which might indicate the existence of a septum) almost for half the length of the valve. The test is rather coarsely fibrous ; there can thus be no doubt as to the generic affinities of the species.

The habit of this species on the whole, especially also the presence of well-marked ears on both sides of the umbo of the small valve, point emphatically to its relationship with the Group Austriella, m., occurring so abundantly in the Alpine Hallstatt Limestones, amongst whose members it seems again to stand nearest to the typical form of this group, *viz.*, *Rhynchonella dilatata*, Suess .

Locality.—Present in one specimen from the red limestone of the Cliff of Chitichun, No. 1, Tibet. It is interesting that the first brachiopod of this occurrence in Tibet, so similar in facies to the Hallstatt Limestone, is a species which bears upon it so markedly the typical characters of the predominant Rhynchonella (Austriella). This seems to be a confirmation of that which has already been said in the Abhandlungen der k.k. geologischen Reichsanstalt, XIV., p. 250, about the striking dependence of these brachiopods upon the facies of the deposits enclosing them. The red marbles of the Chitichun Cliffs are, as is well known, referred to the Muschelkalk (cf. Diener, l.c., p. 64). The European Muschelkalk deposits nearest in facies (Marble of the Schreyeralm, and of Han Bulog) have not yet yielded any species of Rhynchonella which are so near the type of Austriella.

SPIRIGERA (?) NŒTLINGII, nov. sp., Pl. XI , Figs 2, 3.

A very remarkable form, but unfortunately doubtful in many respects especially as regards its horizon and its systematic position. Its entire habit, especially the small beak, recalls a Rhynchonella, which it was also considered to be by its discoverer, F. Stoliczka. The bed from which it comes was regarded as liassic. As several specimens are present, which, however, are all more or less distorted by pressure, one of the broken ones was polished, and a spiral cone of at least fifteen whorls was immediately brought to light. Two fragments of the species prove likewise to be provided with spiral cones, which however, unfortunately, are torn loose from their connection with the crural processes and lie in a displaced position in the interior of the shell, and about whose attachment no data could therefore be acquired; only so much being ascertained from the existence of spiral cones that this brachiopod could not be a Rhynchonellid, according to our present knowledge, but that it must be placed in the Spiriferidæ. In a species, presumably liassic, it was at first only to be supposed that it should belong to the genus Spiriferina ; but a Spiriferina, moreover a liassic one, without any indication of an area, without distinct open deltidium, without the trace of a median septum in the large valve and without the wart-like dotted shell structure, so extraordinarily developed in these forms, would have been such an unusual occurrence that it was impossible to maintain this view. Though in some triassic Spiriferinæ, as for instance in *Mentzelia Fraasi*, m., even the greater number of those characteristic features appear to be reduced almost to complete obliteration, one of them nevertheless remains and suffices to make it recognisable externally as belonging to this genus. Its belonging to Spiriferina could not thus be thought of in the present case. It was thus first intended to place it in the genus Spirigera (Athyris., auct.) without regard to the circumstance that the youngest forms of this genus hitherto known occur in the rhætic formations of the uppermost trias, and that as yet a true Spirigera has never been found in the lias. Regarded as spirigera this species would be the youngest of its genus, supposing it to be really of liassic age. But its reference to Spirigera also is not to be held as proved. It is true that it distantly recalls *Spirigera Tricupii*, m., described from the trias of Balia in Asia Minor (Jahrb. d. geol. Reichsanst., 1892), but this resemblance is again outweighed by the very weak development of its beak, as well as by the circumstance that a sure proof of the existence of median convergent fibres in the test cannot be brought forward, while just these two external features in *Spirigera Tricupii* were decisive for its generic position, though its internal structure is not known. The proof afforded by the spiral cones is unfortunately not sufficient in *Spirigera* (?) *Noetlingii* for the purpose of a safe generic determination, as the attachment of these spiral cones, characteristic of Spirigera, is disturbed in all the polished specimens.

The shell in all the specimens which were before me was of a finely crystalline sugar-like substance, without a trace of punctures. Only in some forms the originally fibrous condition of the shell can here and there and especially at the thick-shelled sides of the beak, be recognised with certainty. The species is, therefore, certainly to be reckoned as belonging to the fibrous-shelled brachiopods, which would be again in favour of Spirigera. But the surface ornamentation of the shell again reminds one strongly of Spiriferina. There is a narrow shallow median sinus in the large valve, a corresponding rounded narrow frontal tongue, and a slightly-marked median lobe in the small valve. The ribbing is not very strong, but the ribs run from the umbo over the whole shell. From two to four ribs can be counted in the sinus, and from five to eight on each of the sides. Some specimens seem to have possessed still more numerous ribs whose number thus varies considerably. The breadth of the sinus and of the frontal tongue are also variable in a corresponding degree. In forms with fewer ribs these are proportionally stronger and more distinct than in specimens bearing more numerous ribs; in such specimens the ribs sometimes die out almost entirely. They always remain low and rounded at the edges.

The beak is, as already mentioned, uncommonly small and delicate for a brachiopod with spires, and might most easily be mistaken for a Rhynchonella beak, the more so as the external appearance of the shell is that of a symmetrical Rhynchonella. It *appears*, however, that the beak possessed a terminal opening. Its margins are rounded, and an area similar to that of the Spiriferidæ is not even indicated. The beak shows when cut and polished thick-shelled lateral walls and a thin-shelled median portion, exactly as in *Spirigera Stoliczkai* (Pl. III., Fig. 8). A median septum in the large valve is wanting. By further grinding and polishing the lateral thickening of the beak is seen to be divided into the outer beak wall, in itself very strong, and in a likewise strong dental support extending to the shell-wall similar to the above-mentioned *Spirigera Stoliczkai* (Pl. III., Fig. 9). The internal structure of the beak is thus also emphatically opposed to the relegation of the species to Spiriferina, although it cannot, on the other hand, be brought forward as an argument for its Spirigera nature; but it does not militate *against* the latter. The points in favour of placing this species in the genus Spirigera nevertheless preponderate. Among the species of the Muschelkalk described above there exists a form generically somewhat uncertain, *viz.*, *Rhynchonella Salteriana*, Stol. (Pl. II., Figs 14, 15), about which it does not seem at all clear to me whether it possesses spiral cones or not. Should it possess such cones, this species might perhaps stand nearest to *Spirigera* (?) *Nœtlingii* just described, and probably even be united with it generically.

Locality.—Collected by Stoliczka in the 'Lias' of Nio Sumdo, Karnag, and determined by him to be a Rhynchonella. The remarks of Stoliczka in his 'Geological Observations in Western Tibet' (Mem. Geol. Survey of India, V., 1866, pp. 345, 346) refer without doubt to this species. As already mentioned, the geological age of this interesting brachiopod seems yet unsettled, and it might perhaps not be impossible to assume it to have originated in triassic or still older beds.

This form seems to occur in Panga-La (Pangpo-La, according to Stoliczka, l.c., p. 342, ff.), in Ladakh, as well as in Nio Sumdo in Karnag. It may be mentioned that among the specimens from Karnag there is also a Belemnite, but the rock containing it does not seem to be identical with the rock from which the brachiopod species comes.

V.—RETROSPECT AND CONCLUSION.

The species described in the foregoing pages are distributed in the different groups of beds of the trias of the Himálayas as follows:—

I.—SPECIES FROM THE LOWER TRIAS.

(THE BUNTSANDSTEIN OR WERFEN SLATES HORIZON.)

Ia.—From the Lower or Otoceras Horizon.

Pseudomonotis Griesbachi, nov. sp.

Pseudomonotis Painkhandana, nov. sp.
Avicula aff. Venetianæ, Hauer.
Gervillia (?) sp.
Myophoria (?) sp.
Nucula (?) sp.

RHYNCHONELLA (Norella) **PROCREATRIX**, nov. sp.

BELLEROPHON cf. Vaceki, nov. sp.

I. b.—From the Upper or Subrobustus Horizon.

Pseudomonotis (? Avicula) himaica, nov. sp.
Pseudomonotis decidens, nov. sp.

II.—SPECIES FROM THE MIDDLE TRIAS (THE MUSCHELKALK).

IIa. From the Hauptcomplex of the Muschelkalk, including the beds with Rhynchonella Griesbachi, m., and Spiriferina Stracheyi, Salt.

From the horizon of Rhynchonella Griesbachi :—
  Rhynchonella Griesbachi, nov. sp.
  Rhynchonella (Norella) Kingi, nov. sp.
  Retzia himaica, nov. sp.
From the horizon of Spiriferina Stracheyi :—
  Rhynchonella Dieneri, nov. sp.
  Spiriferina Stracheyi, Salt.
  Spirigera Stoliczka, nov. sp.
  Terebratula (Dielasma) himalayana, nov. sp.
From the remaining mass of the Muschelkalk, without a more exact horizon being assigned:—
  Rhynchonella cf. trinodosi, Bittn.
  Rhynchonella mutabilis, Stol.
  Rhynchonella (?) Salteriana, Stol.
  Rhynchonella Theobaldiana, Stol.
  Spiriferina Lilangensis, Stol.
  Spiriferina (Mentzelia) Kœveskalliensis (Suess) Bœckh.
  Terebratula (Dielasma) Himalayana, nov. sp.
  Terebratula (Dielasma) aff. Himalayanæ, nov. sp.
  Terebratula (Cœnothyris) cf. vulgaris, Schloth.
  Aulacothyris Lilangensis, nov. sp.

IIb. From the Transition Horizon of Daonella indica, m., and chiefly from beds probably of Ladinic age.

From rock with Daonella Lommeli from Muth in Spiti :—
  Daonella Lommeli, Wissm. sp.

From grey crinoidal limestone underlying the bed with Daonella indica :—
- Rhynchonella Rimkinensis, nov. sp.
- Myoconcha, sp.

From the horizon of Daonella indica :—
- Daonella indica, nov. sp.
- ? Daonella aff. indicæ, nov. sp.
- ? Daonella Spitiensis, nov. sp.
- Aulacothyris Nilangensis, nov. sp.
- Spirigera hunica, nov. sp.
- Rhynchonella (Norella) Kingi, nov. sp.
- Rhynchonella (Norella) Tibetica, nov. sp.
- Discina, sp.

III. SPECIES FROM THE UPPER TRIAS (KEUPER).

IIIa. From the Lower Division of the upper trias.

IIIa.¹ From the horizon of Halobia comata, and the succeeding Tropites beds.

From the horizon of Halobia comata :—
- Spiriferina Shalshalensis, nov. sp.
- Retzia Schwageri, Bittn., var. Asiatica, nov.
- Rhynchonella Laucana, nov. sp.
- Halobia fascigera, nov. sp.
- Halobia comata, nov. sp.
- Avicula (?) Girthiana, nov. sp.
- Cassianella, pl. sp.
- Lima, sp.

From the Tropites beds (Hauerites and Halorites beds):—
- Rhynchonella Bambanagensis, nov. sp.
- Halobia cf. comata, nov. sp.
- Cassianella, sp.
- Lima, sp.
- Lima (?) serraticosta, nov. sp.
- Anodontophora Griesbachi, nov. sp.

IIIa.² From the horizon of Spiriferina Griesbachi and the succeeding Sagenites beds :—

- Spiriferina Griesbachi, nov. sp.
- Retzia Schwageri, Bittn., var. Asiatica, nov.
- Spirigera Dieneri, nov. sp.
- Amphiclina, sp.
- Rhynchonella Bambanagensis, nov. sp.
- Rhynchonella Martoliana, nov. sp.

Aulacothyris Joharensis, nov. sp.
Cassianella pulchella, nov. sp.
Pecten biformatus, nov. sp.
Pecten interruptus, nov. sp.
Lima cumaunica, nov. sp.
Anodontophora Griesbachi, nov. sp.

IIIb. From the Upper Division of the upper trias :—

Megalodon cultridens, nov. sp.
Megalodon Ladakhensis, nov. sp.
Dicerocardium Himalayense, Stol.

IV. ADDENDUM:—

Myophoria, ex aff. ovatæ, Goldf.
Rhynchonella Middlemissii, nov. sp.
Spirigera (?) Nœtlingii, nov. sp.

The total number of the brachiopoda and lamellibranchiata of the trias of the Himálayas described in the foregoing pages does not thus amount to more than about 60 species, which fall to these classes in about equal proportions; this is a minimum number considering their richness in species which is already known in the Alpine trias and which is far from being exhausted. Our knowledge of the brachiopoda and lamellibranchiata of the trias of the Himálayas compared with this is at present in its infancy.

The few brachiopods of the trias of the Himálayas yet known are assigned to the genera Terebratula (with Dielasma and Cœnothyris), Aulacothyris, Rhynchonella (with Norella and Austriella), Spiriferina, Mentzelia, Spirigera (Athyris, auct.), Amphiclina, Retzia and Discina. The lamellibranchs belong to the genera Avicula, Pseudomonotis, Gervillia, Cassianella, Halobia, Daonella, Pecten, Lima, Myophoria, Megalodon, Dicerocardium and Anodontophora (Anoplophora). These are, without exception, also genera well-known and generally distributed in the Alpine trias. Species agreeing specifically with those of the Alpine trias are only sparingly represented. As such may be enumerated the Muschelkalk brachiopoda *Mentzelia Kœveskalliensis*, *Terebratula* (*Cœnothyris*) cf. *vulgaris*, and *Rhynchonella* cf. *trinodosi*, of which the two latter cannot however be identified with full certainty, because they occur only as a few forms. Besides these there is only *Daonella Lommeli* that can be named as undoubtedly identical with European species. Of forms closely related to European species the following may be added here :—*Pseudomonotis Griesbachi*, *Avicula* aff. *Venetianœ*, *Bellerophon* cf. *Vaceki*, *Retzia Schwageri* (var. *Asiatica*), and perhaps *Rhynchonella Laucana.* All the rest of the species, thus by far the greater number of them, may be regarded as well differentiated new species, from which the conclusion may be drawn that the brachiopoda and lamellibranchiata are, in their totality, considerably different from those of the Alpine trias. As a few strikingly deviating types, which are known so far to be entirely absent from the Alpine trias, the following may be pointed out, namely, *Retzia himaica*, *Spiriferina Stracheyi*, *Spiriferina Griesbachi*, *Rhynchonella Salteriana*; further, *Lima serraticosta*, *Pecten biformatus*, and perhaps also *Megalodon cultridens*. It is remarkable that the genus Spiriferina is represented among them by two species. One of them, *S. Griesbachi*, possesses relationship with a form in the trias of Asia Minor.

The separate faunæ of the trias of the Himálayas offer an opportunity for the following remarks :—

I*a*. The oldest of these faunæ, namely, that with *Pseudomonotis Griesbachi*, from the lowest Otoceras beds, is proportionally rich in characters which harmonise with those of European species. Its most important and abundant members, *viz.*, *Pseudomonotis Griesbachi* itself, together with *Avicula* aff. *Venetianae*, and *Bellerophon* cf. *Vaceki*, are extremely closely related to Alpine species of the Werfen Slates, or are even identical with them. Some of the forms which remain specifically undetermined (e.g., Gervillia, sp., Myophoria, sp.) seem to possess closer relationship to permian forms. The appearance of a small Rhynchonella from the group of Norellæ is new, while only hingeless brachiopods are known in the Alpine Werfen Slates.

I*b*. The bivalves of the Subrobustus beds have hitherto been restricted to two species, of which one appears to be only a straggler of the Pseudomonotidæ of the Otoceras beds, while the other stands probably in closer relationship to a species of the North American trias.

II*a*. The brachiopod fauna of the Muschelkalk (in the strict sense) is of greater interest. Among the species is one of the few identical with Alpine forms, *viz.*, *Mentzelia Kœveskalliensis*, and two others, namely, *Terebratula* cf. *vulgaris*, and *Rhynchonella* cf. *trinodosi*, are at least very near to Alpine species. To the group of *Rhynchonella trinodosi* also belong several other species of Rhynchonella of the Asiatic trias; that is, *Rhynchonella Griesbachi*, *R. Dieneri*, *R. mutabilis*. The group of Norella extends from the lower trias to the Muschelkalk. Very characteristic is *Spiriferina Stracheyi* which, with *Spirigera Stoliczkai* and *Dielasma Himalayanum*, forms a small but widely distributed little fauna of its own, to which, perhaps, belong some other Muschelkalk brachiopods from Spiti, as the brachiopods of this horizon in the Himálayas are generally distinguished by a wider distribution. This is the case, for instance, with *Mentzelia Kœveskalliensis* mentioned above, which is known from no less than four localities, *viz.*, Lilang, Silakank Pass, Rimkin-Paiar and Bambang section; it is further very striking in *Rhynchonella Salteriana*, one specimen of which comes from Lilang, in Spiti, while a second was collected in the Shalshal Cliff; this obtains in a still greater degree in the little fauna mentioned above with *Spiriferina Stracheyi*, about which more will be said further on. It seems to result from this that the conditions of the facies and the succession of beds must remain extremely constant, extending over large areas in the regions of the Himálayan trias.

The stratigraphical relations of the fauna with *Spiriferina Străcheyi* to the fauna with *Rhynchonella Griesbachi* require a more minute elucidation, as already referred to. From their purely palæontological characters one might be inclined to consider the fauna with *Spiriferina Stracheyi* to be older than the brachiopod fauna of the European Muschelkalk with *Terebratula vulgaris*, whose typical species has only been found very sparingly, if at all, in the Himálayas, while others of the most abundant species associated with it, such as *Spirigera trigonella* and *Mentzelia Mentzeli*, have hitherto been entirely wanting in the trias of the Himálayas. One thing may here be pointed out. Diener, in taking the chief mass of the (ptychites-bearing) Muschelkalk of the Himálayas as the "Upper" Muschelkalk in the older sense, emphasises the fact that the thin brachiopod-bearing beds at its base are to be regarded as representing the so-called Binodosus-zone of the Alps, or, in a word, as Lower Muschelkalk, by which it is overlooked that this "Binodosus-zone" lies proportionately high in the mass of the Alpine Muschelkalk, and that then a representative of the thick underlying Muschelkalk beds, poor in fossils, must be sought for actually in the Subrobustus beds of the Himálayas (*cf.* Verhandl. der geol. Reichsanst., 1897, p. 100).

As types as yet quite foreign among the brachiopods of the Muschelkalk of the Himálayas, *Retzia himaica* and *Rhynchonella* (?) *Salteriana* are put prominently forward.

II*b*. The isolated occurrence of *Daonella Lommeli* in Spiti, and the more widely distributed horizon of *Daonella indica* have already been indicated as presumable equivalents of the upper or Ladinic group of beds of the Alpine Muschelkalk. In the horizon of *Daonella indica* a brachiopod fauna, poor in species, also occurs, in which Norellæ especially predominate ; these began to appear already in the lowest Otoceras beds in the Himálayas.

III*a*. In this horizon, mostly composed of marly beds, especially in its lower division, the Halobiæ from the group of *Halobia rugosa* (*viz.*, *H. comata*, *H. fascigera*) are particularly striking. Among other associated species may be pointed out the not rare species of Cassianella, *Rhynchonella Laucana*, which comes near a Hallstatt species, and the vertically and horizontally distributed *Retzia Schwageri*. The latter, together with some other forms, (*e.g.*, *Rhynchonella Bambanagensis*, *Lima serraticosta*, *Anodontophora Griesbachi*), connects the lower with the upper division of this group of beds.

The small but characteristic fauna of *Spiriferina Griesbachi* and *Spirigera Dieneri*, which both possess a remarkably palæozoic habit, lies in the upper division of the group of beds III*a*. In this fauna the first Asiatic representative of the brachiopod family of the Koninckiidæ, namely, a small Amphiclina, so important in the Alpine trias, was also recorded, and, in addition to it, also peculiar, new, elegantly sculptured species of Cassianella and Pecten (*viz.*, *Cassianella pulchella*, *Pecten biformatus*). In the uppermost layers of this group of beds, the so-called Sagenites-beds of Diener, *Anodontophora Griesbachi*, seems to preponderate.

III*b*. The fauna of the thick uppermost limestone masses in the trias of the Himálayas is as yet very sparingly represented, a circumstance which may well be attributed chiefly to the inaccessibility of the mountain region composed of these masses. Only Megalodon and Dicerocardium are recorded as abundant, among which *Dicerocardium Himalayense* stands very near its European congeners, while *Megalodon cultridens* is very strikingly distinguished by its strongly devoloped hinge-dentition from all Alpine species examined in connection with this feature. Very noteworthy is the absence of the genus belonging to the Rhynchonellidæ, *viz.*, Halorella, so abundant in the Alpine Dachsteinkalk. Stoliczka has, it is true, already mentioned a species of it from the uppermost trias deposits of the Himálayas, but this statement is founded, as I have convinced myself, upon incompletely preserved fragments of a many-ribbed Rhynchonella which cannot at all be regarded as Halorella. That species of Halorella may, however, also occur in the trias of the Himálayas, might be inferred with great probability from the circumstance that members of this genus have been found by Stoliczka in the Pamir region, as Prof. E. Suess has recently shown. What is said of Halorella may equally be applied to the important genus Monotis, as yet wanting in the trias of the Himálayas (cf. E. Suess, Beiträge zur Stratigraphie Centralasiens, etc., in Denkschr. der Kais. Akad. d. Wiss., Wien, 1894, LXI. Bd. p. 30-32).

III*c*. The uppermost division of the Alpine trias, namely, that of the Kössen beds, is not represented in the palæontological material before me. It is particularly desirable to point out those fossil-bearing horizons, or separate faunæ which deserve special attention by reason of their wide distribution within the triassic region of the Himálayas. They are as follow :—

1. *The lowest fauna of the Otoceras beds with Pseudomonotis Griesbachi,* occurring in the Shalshal Cliffs, at Kiunglung near the Niti Pass and at Kuling in Spiti.
2. *The fauna of the horizon with Spiriferina Stracheyi,* which appears to be extremely widely distributed. It is known in the Shalshal Cliffs near Rimkin-Paiar, in the Niti Pass (Rajhoti) and in numerous localities in Spiti (Lilang, Muth, Kuling, Khar, Drangkhar) and finally in the Kali River valley. The fauna with *Rhynchonella Griesbachi* is so far known only at Shalshal.
3. *The fauna of the horizon with Daonella indica* is proved to be in the Shalshal Cliffs, in the Lissar valley, at Dogkwa Aúr, in the Hop Gadh district, at Ganesganga, and may also occur at Kuling, Khar, and other localities in Spiti.
4. *The fauna of the horizon* with *Halobia comata* is known in the Bambanag section, and at Kiunglung in the vicinity of the Niti Pass.
5. *The fauna with Spiriferina Griesbachi* is known in the Bambanag section, and, supposing that *Spiriferina Tibetica,* Stol., belongs to it, also farther to the north-west in the Manirang Pass, as well as at Kibber and Kuling in Spiti. The rest of the species of this fauna have hitherto been found only in the Bambanag section.
6. *The Megalodon fauna* of the so-called " Para-limestone " may finally here be added. It is widely distributed in Spiti, Rupshu, Karnag, Ladakh, etc.

EXPLANATION OF THE PLATES.

PLATE I.

Figs. 1-4. Pseudomonotis Griesbachi, nov. sp., p. 2, from the Otoceras beds of the Shalshal section, near Rimkin-Paiar, *viz.* Figs. 1 and 2, the lef tor inflated valve (Fig. 2 with enlargement of the anterior ear), Figs. 3 and 4 the right or flat valve of this species.

Fig. 5. Pseudomonotis Painkhandana, nov. sp., p. 5, from the Otoceras beds of the Shalshal section, near Rimkin-Paiar, left valve natural size, and twice enlarged.

Figs. 6, 7. Gervillia (?) sp. p. 8, from the Otoceras beds of the Shalshal section, near Rimkin-Paiar; left valves.

Fig. 8. Avicula aff. Venetianæ, Hauer, p. 6, from the Otoceras beds of the Shalshal section; a left valve, partly a cast.

Figs. 9, 10. Myophoria (? Schizodus) sp., p. 8, from the Otoceras beds of the Shalshal section; both valves.

Fig. 11. Nucula (?) sp., p. 8, from the Otoceras beds of the Shalshal section.

„ 12. Rhynchonella (Norella) procreatrix, nov. sp., p. 9, from the Otoceras beds N.-W. of Kiunglung.

Figs. 13, 14. Bellerophon Vacekі, nov. sp., p. 9, from the Lower Werfen slates of the Mendelstrasse in South Tyrol, Fig. 13, cast, Fig. 14, specimen with shell. Figured for comparison with :—

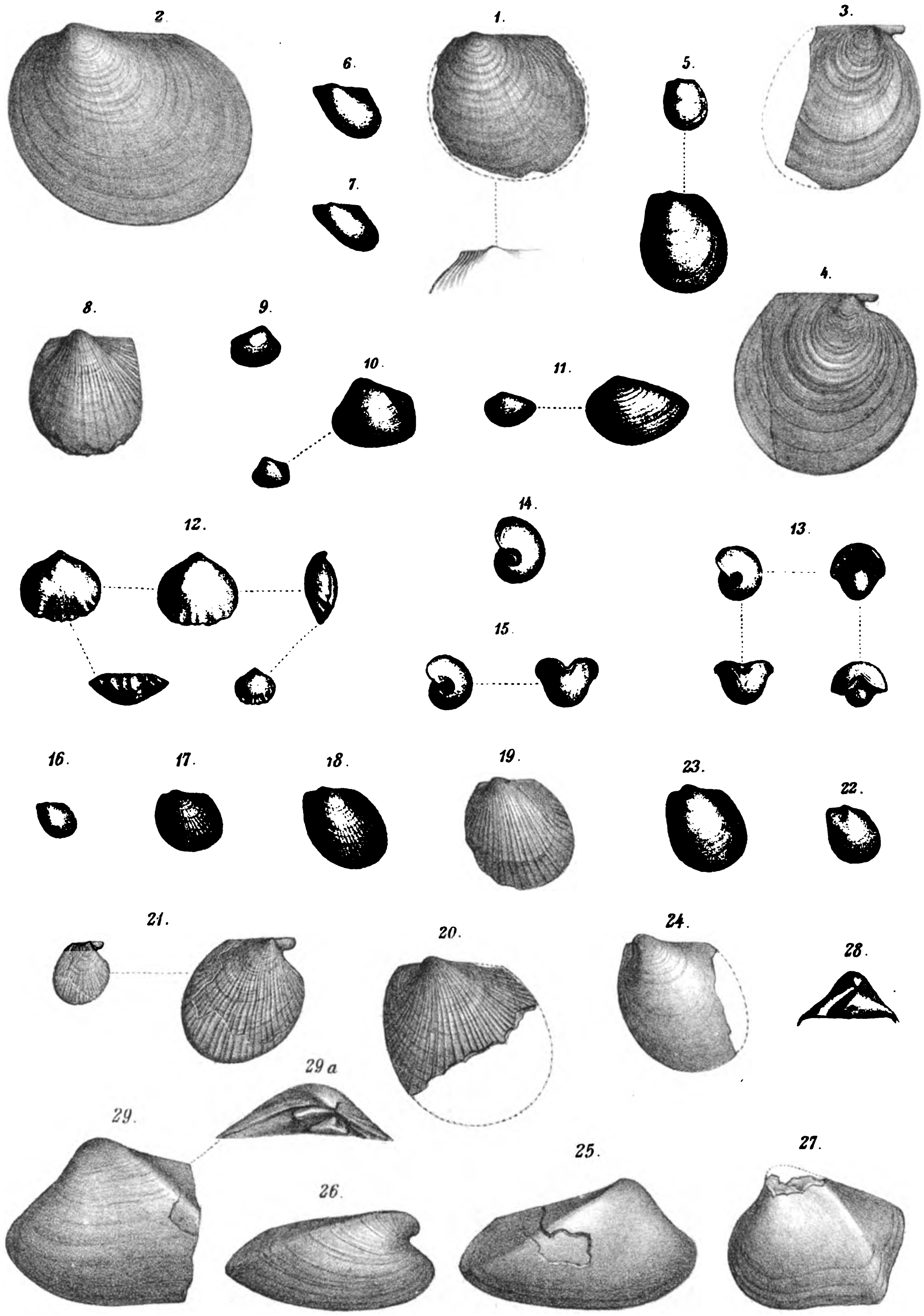
Fig. 15. Bellerophon cf. Vaceki, nov. sp., p. 9, from the Otoceras beds from the locality N.-W. from Kiunglung; a cast.

Figs. 16-21. Pseudomonotis (? Avicula) himaica, nov. sp., p. 10, from the Subrobustus-beds in the Shalshal section, near Rimkin-Paiar. Figs. 16-20 left valves, Fig. 21, a right valve.

„ 22-24. Pseudomonotis decidens, nov. sp., p. 11, from the Subrobustus-beds of the Shalshal section; three left valves.

„ 25-28. Myophoria, ex aff. ovatæ, Goldf., p. 67, from a triassic rock, of which the exact horizon is not known; from the Dras Valley in Kashmir. Figs. 25, 26, right valves, 27-29, left valves, 28 and 29*a*, the hinge of the left valve, 29*a*, better preserved; 28 in a rolled condition, and not quite correctly figured.

HIMALAYAN TRIAS BRACHIOPODA, LAMELLIBRANCHIATA ETC.



A. Swoboda del. et lith.
Th. Bannwarth print.

PLATE II.

Figs. 1-7. Rhynchonella Griesbachi, nov. sp., p. 12, from the Muschelkalk horizon of *Rhynchonella Griesbachi* in the Shalshal section, near Rimkin-Paiar. Figs. 1-5, different forms of this species; Fig. 6, a specimen with dental plates and septum of the left valve exposed; Fig. 7, with section of the umbones.

" 8, 9. Rhynchonella Dieneri, nov. sp., p. 14, from the beds with *Spiriferina Stracheyi* in the Shalshal section, near Rimkin-Paiar.

Fig. 10. Rhynchonella, aff. Trinodosi, Bittn., p. 14, from the Muschelkalk of Muth in Spiti.

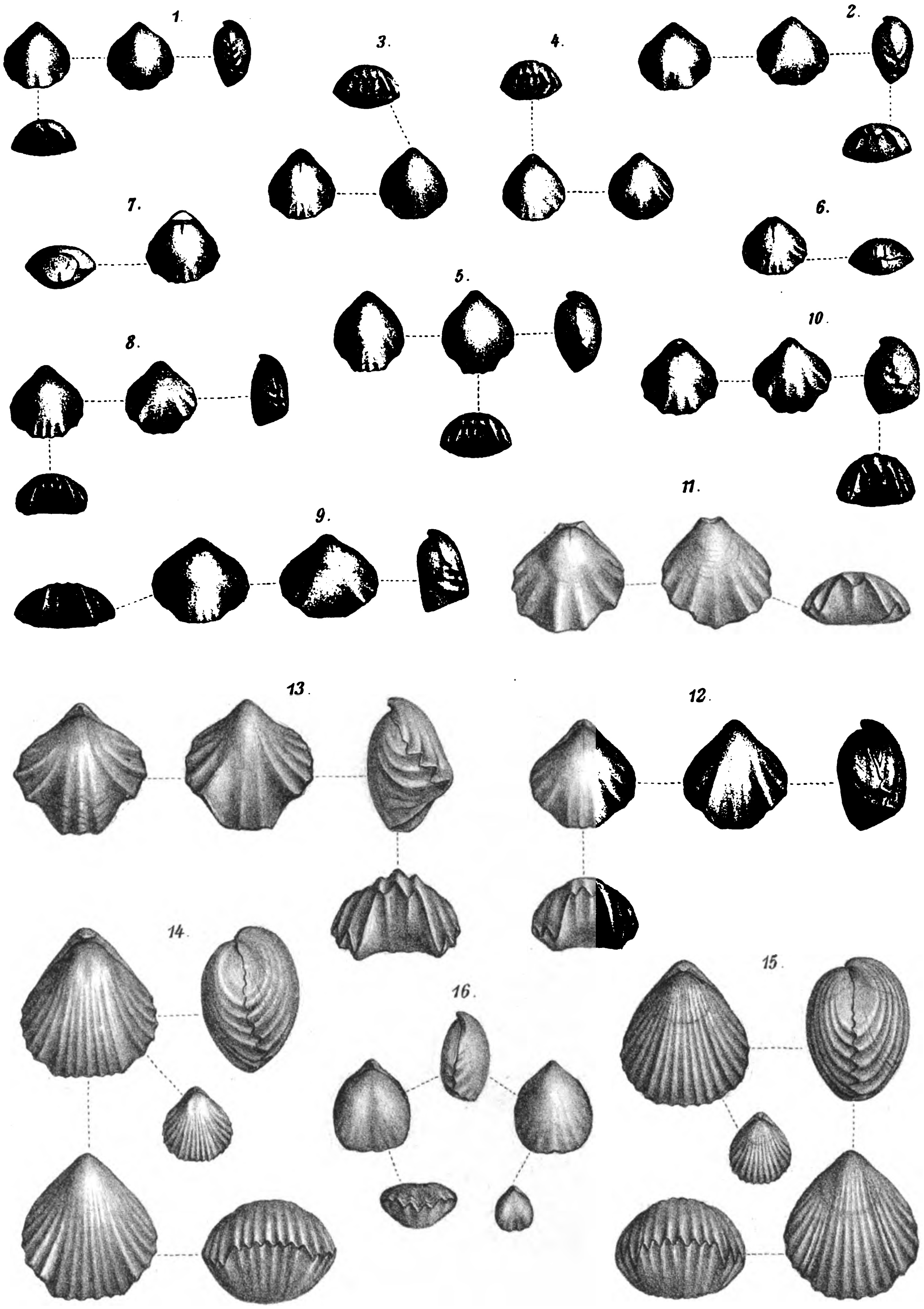
Figs. 11, 12, 13. Rhynchonella mutabilis, Stol., p. 15, from Lilang on the Lingti river in Spiti. The three figured forms are at the same time the originals of Stoliczka's figures of the species.

" 14, 15. Rhynchonella Salteriana, Stol., p. 15, Stoliczka's original specimen (Fig. 14 from Lilang on the Lingti river, the second specimen (Fig. 15) collected by Diener in the Upper Muschelkalk of the Shalshal section, near Rimkin-Paiar.

Fig. 16. Rhynchonella (Norella) Kingi, nov. sp., p. 17, from the horizon of *R. Griesbachi*, in the Shalshal section, near Rimkin-Paiar. Cf. Plate VI. Figs. 14, 15, 16.

HIMALAYAN TRIAS BRACHIOPODA, LAMELLIBRANCHIATA ETC.

Pl. II.



A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE II.

Figs. 1-7. Rhynchonella Griesbachi, nov. sp., p. 12, from the Muschelkalk horizon of *Rhynchonella Griesbachi* in the Shalshal section, near Rimkin-Paiar. Figs. 1-5, different forms of this species; Fig. 6, a specimen with dental plates and septum of the left valve exposed; Fig. 7, with section of the umbones.

" 8, 9. Rhynchonella Dieneri, nov. sp., p. 14, from the beds with *Spiriferina Stracheyi* in the Shalshal section, near Rimkin-Paiar.

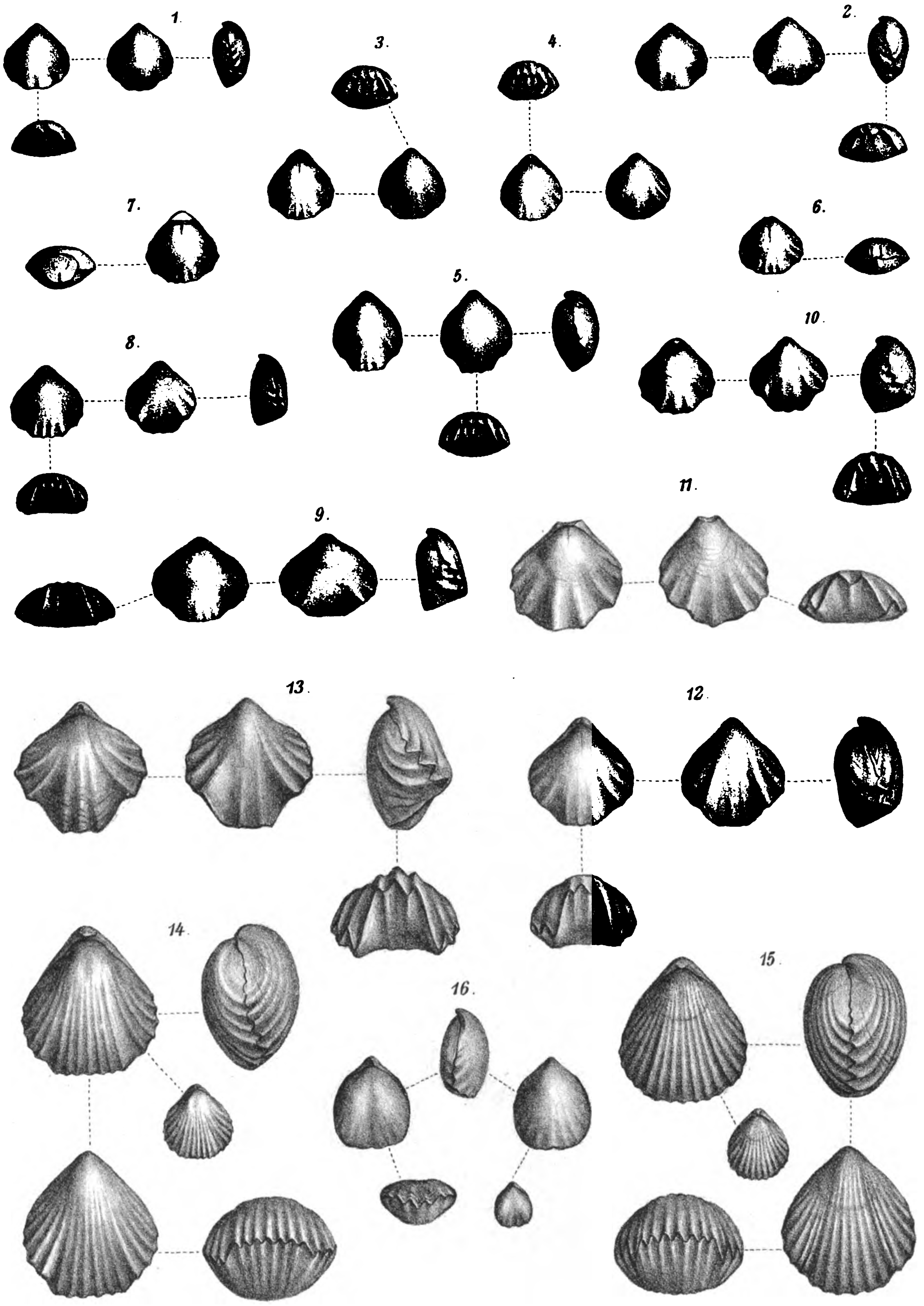
Fig. 10. Rhynchonella, aff. Trinodosi, Bittn., p. 14, from the Muschelkalk of Muth in Spiti.

Figs. 11, 12, 13. Rhynchonela mutabilis, Stol., p. 15, from Lilang on the Lingti river in Spiti. The three figured forms are at the same time the originals of Stoliczka's figures of the species.

" 14, 15. Rhynchonella Salteriana, Stol., p. 15, Stoliczka's original specimen (Fig. 14 from Lilang on the Lingti river, the second specimen (Fig. 15) collected by Diener in the Upper Muschelkalk of the Shalshal section, near Rimkin-Paiar.

Fig. 16. Rhynchonella (Norella) Kingi, nov. sp., p. 17, from the horizon of *R. Griesbachi*, in the Shalshal section, near Rimkin-Paiar. Cf. Plate VI. Figs. 14, 15, 16.

HIMALAYAN TRIAS BRACHIOPODA, LAMELLIBRANCHIATA ETC.



A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE III.

Figs. 1-17. SPIRIGERA (ATHYRIS) STOLICZKAI, nov. sp., p. 23, in different stages of development, and from different localities.

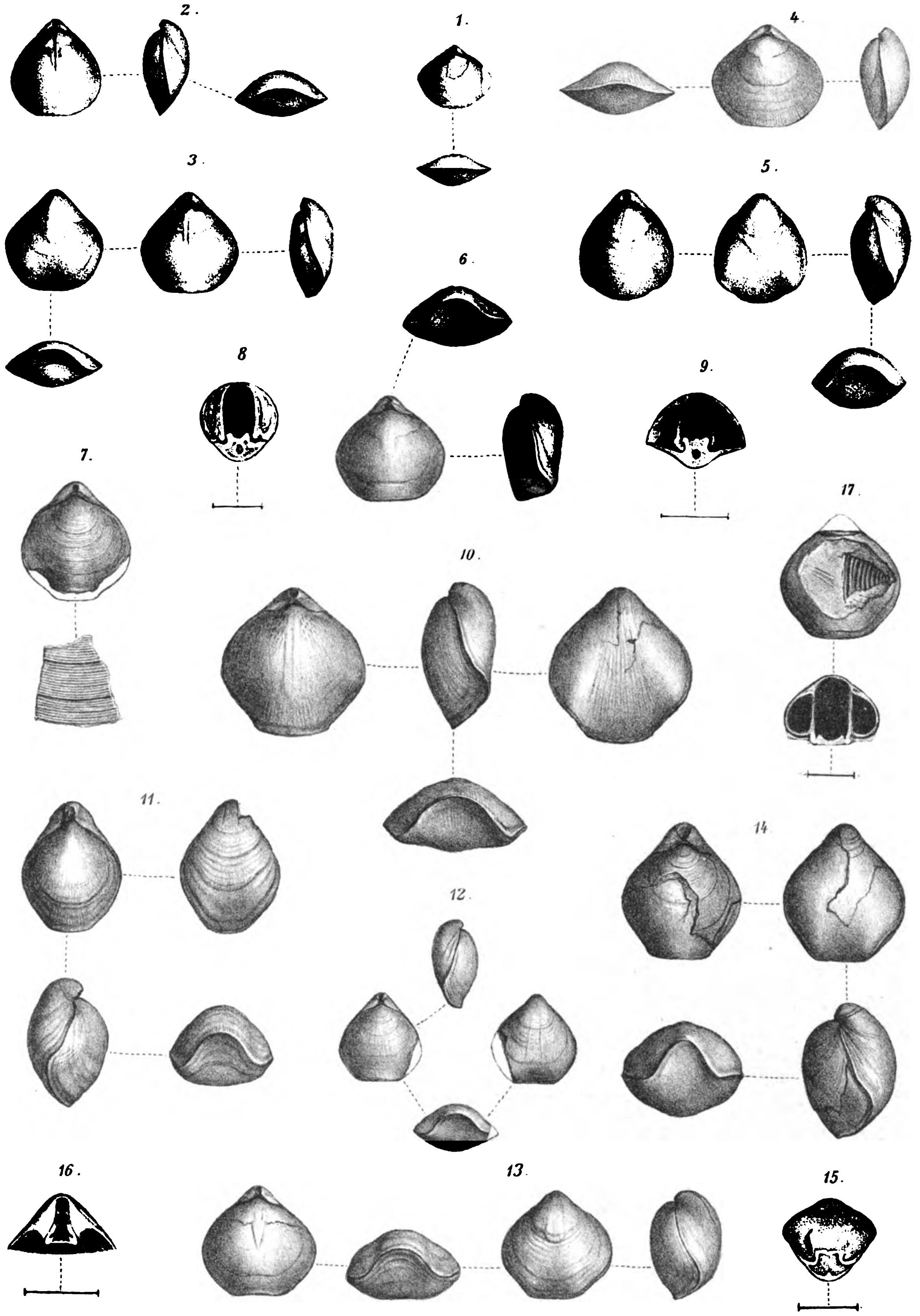
„ 1-9. Specimens from the beds with SPIRIFERINA STRACHEYI, collected by Diener on the 27th August, 1892 at Rimkin-Paiar; Fig. 1, young specimen without sinus; Figs. 2-6, adult specimens of wider and narrower shape, for the most part casts; Fig. 7, a form with the shell; Figs. 8,9, cross-sections of the umbonal region, to show the dental plates and lateral thickenings of the beak, as well as the cavity in the umbo of the small valve.

„ 10, 11. Specimens from a second locality near Rimkin-Paiar, S. E. (collected by Diener on the 2nd September, 1892. Fig. 10, a broader and flatter, Fig. 11 a narrower, thicker, form; the latter with dental plates visible externally, and lateral thickenings of the beak partly broken off.

„ 12, 17. Specimens from Lilang in Spiti, collected by F. Stoliczka; among them Fig. 15, a cross-section with the dental plates disappearing downwards; Fig. 16, a longitudinal section with the hollow umbo of the small valve; Fig. 17, a weathered specimen with an exposed spiral cone, and the beak cut and polished to show the dental plates.

Geol. Surv. of India. Pl. III.

HIMALAYAN TRIAS BRACHIOPODA, LAMELLIBRANCHIATA ETC.



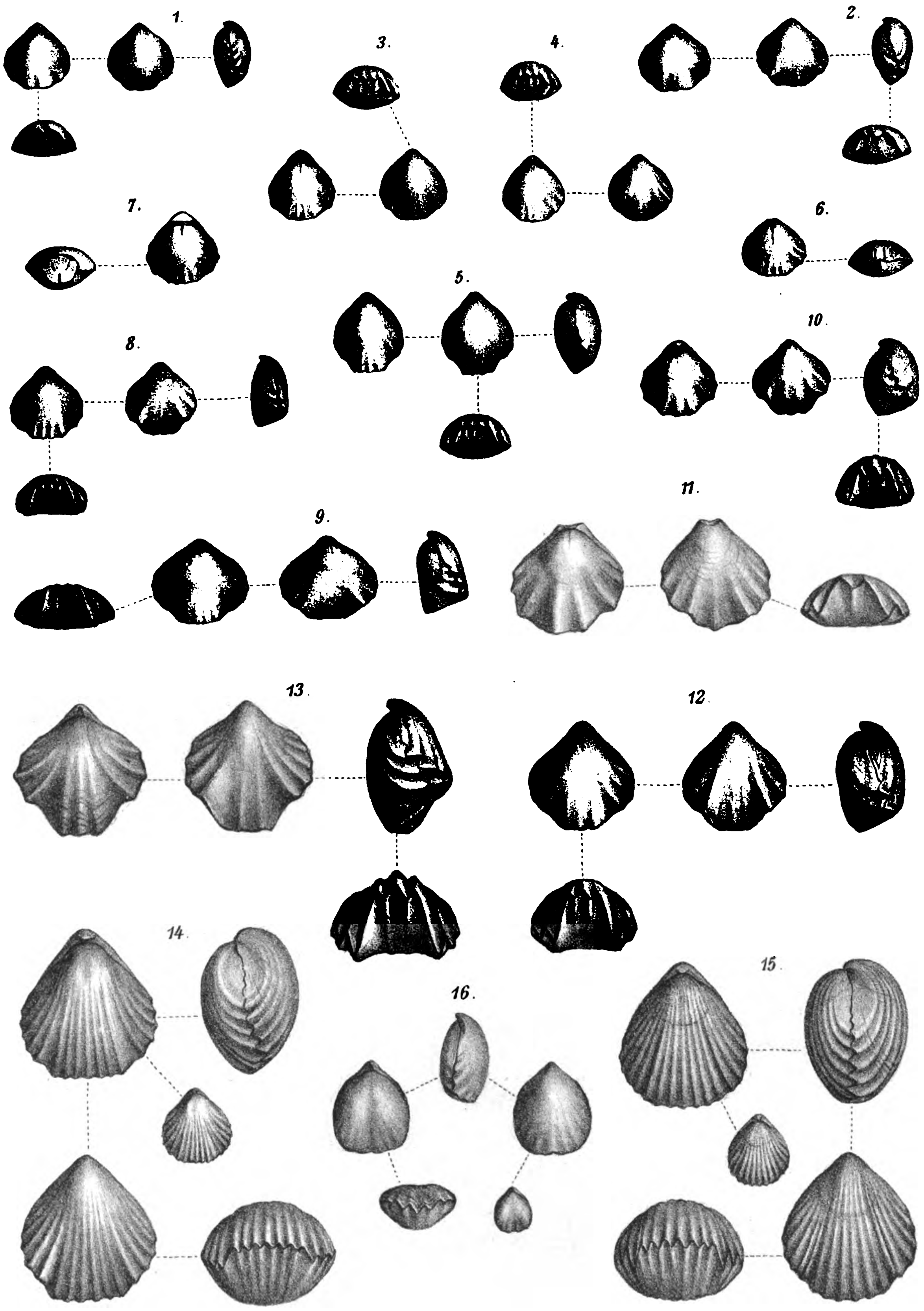
A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE II.

Figs.	1-7.	RHYNCHONELLA GRIESBACHI, NOV. SP., p. 12, from the Muschelkalk horizon of *Rhynchonella Griesbachi* in the Shalshal section, near Rimkin-Paiar. Figs. 1-5, different forms of this species; Fig. 6, a specimen with dental plates and septum of the left valve exposed; Fig. 7, with section of the umbones.
"	8, 9.	RHYNCHONELLA DIENERI, NOV. SP., p. 14, from the beds with *Spiriferina Stracheyi* in the Shalshal section, near Rimkin-Paiar.
Fig.	10.	RHYNCHONELLA, AFF. TRINODOSI, BITTN., p. 14, from the Muschelkalk of Muth in Spiti.
Figs.	11, 12, 13.	RHYNCHONELLA MUTABILIS, STOL., p. 15, from Lilang on the Lingti river in Spiti. The three figured forms are at the same time the originals of Stoliczka's figures of the species.
"	14, 15.	RHYNCHONELLA SALTERIANA, Stol., p. 15, Stoliczka's original specimen (Fig. 14 from Lilang on the Lingti river, the second specimen (Fig. 15) collected by Diener in the Upper Muschelkalk of the Shalshal section, near Rimkin-Paiar.
Fig.	16.	RHYNCHONELLA (NORELLA) KINGI, NOV. SP., p. 17, from the horizon of *R. Griesbachi*, in the Shalshal section, near Rimkin-Paiar. Cf. Plate VI. Figs. 14, 15, 16.

HIMALAYAN TRIAS BRACHIOPODA, LAMELLIBRANCHIATA ETC.



A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE III.

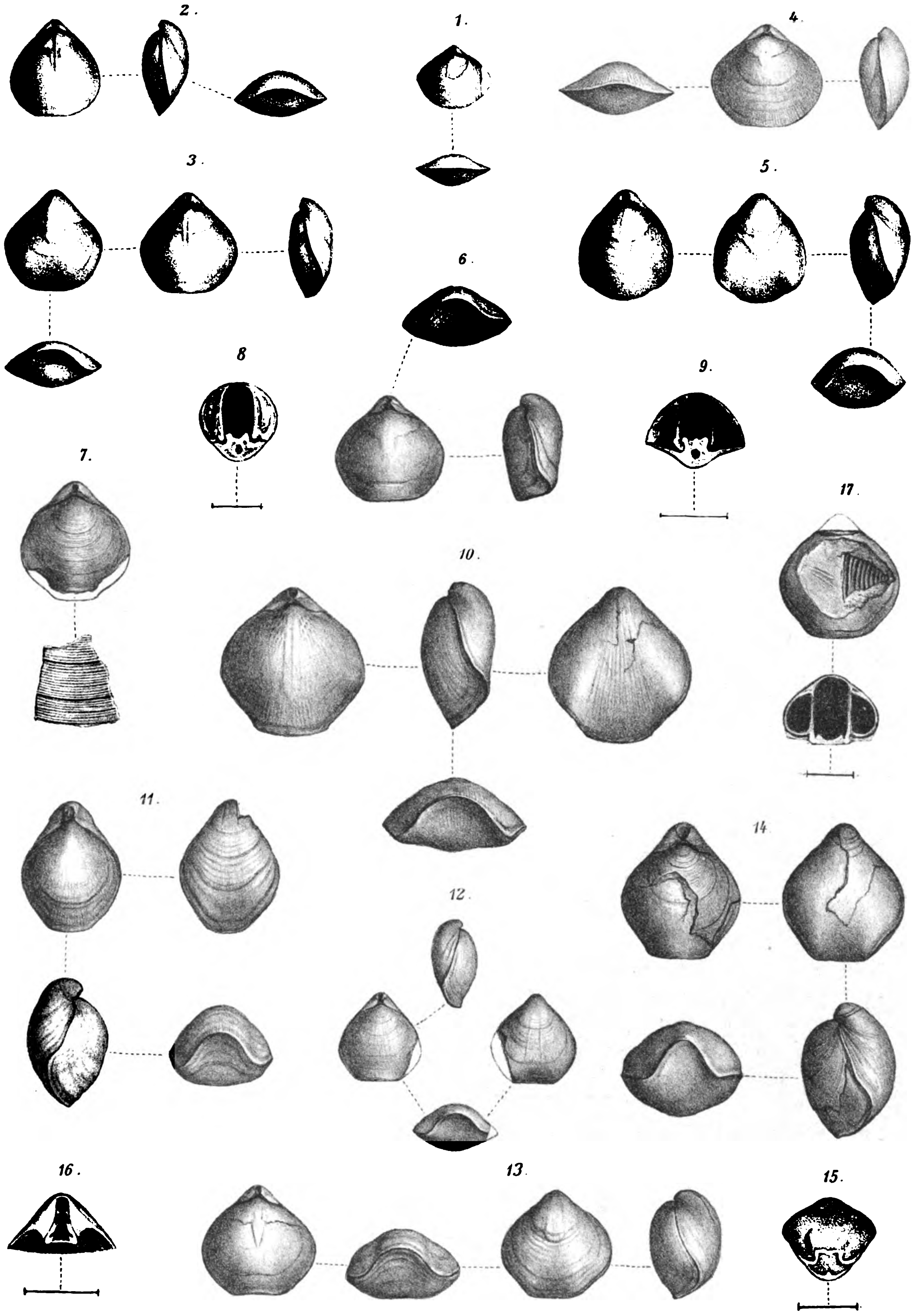
Figs. 1-17. **Spirigera (Athyris) Stoliczkai**, nov. sp., p. 23, in different stages of development, and from different localities.

„ 1-9. Specimens from the beds with **Spiriferina Stracheyi**, collected by Diener on the 27th August, 1892 at Rimkin-Paiar; Fig. 1, young specimen without sinus; Figs. 2-6, adult specimens of wider and narrower shape, for the most part casts; Fig. 7, a form with the shell; Figs. 8,9, cross-sections of the umbonal region, to show the dental plates and lateral thickenings of the beak, as well as the cavity in the umbo of the small valve.

„ 10, 11. Specimens from a second locality near Rimkin-Paiar, S. E. (collected by Diener on the 2nd September, 1892. Fig. 10, a broader and flatter, Fig. 11 a narrower, thicker, form; the latter with dental plates visible externally, and lateral thickenings of the beak partly broken off.

„ 12, 17. Specimens from Lilang in Spiti, collected by F. Stoliczka; among them Fig. 15, a cross-section with the dental plates disappearing downwards; Fig. 16, a longitudinal section with the hollow umbo of the small valve; Fig. 17, a weathered specimen with an exposed spiral cone, and the beak cut and polished to show the dental plates.

HIMALAYAN TRIAS BRACHIOPODA,
LAMELLIBRANCHIATA ETC.



A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE IV.

Fig. 1. Spiriferina Shalshalensis nov. sp., p. 42, from the Shalshal section, near Rimkin-Paiar, from the upper trias.

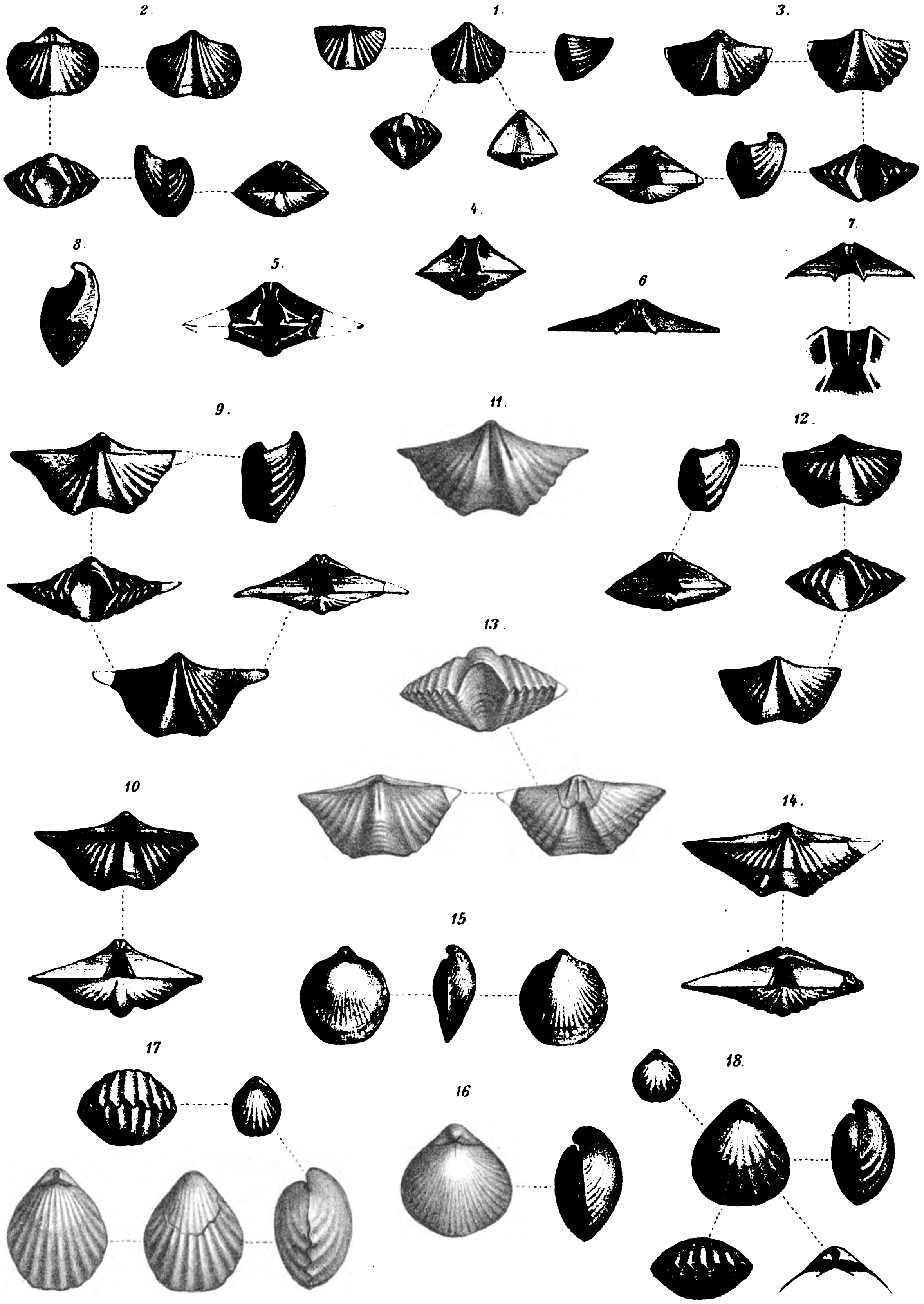
„ 2. Spiriferina Lilangensis, Stol., p. 20, Stoliczka's original specimen, from Lilang in Spiti.

Figs. 3-14. Spiriferina Stracheyi, Salter, p. 18, the typical form of the horizon with *Spiriferina Stracheyi*; *viz.* Figs. 3-11 from Rimkin-Paiar. Fig. 3, a young specimen, still without the wing-like extensions (the front view is inaccurate, as the frontal lobe is drawn much too high, cf. Fig. 12); Fig. 4, with umbonal region cut and polished; Figs. 5-7, sections of the beaks of broader, older specimen; in Fig. 6,7 the beak only very slightly cut, in order to show the callosity at its apex; Fig. 8, a specimen with the median septum of the large valve broken through the centre; Fig. 9, a strongly winged form; Fig. 10, a specimen attached to the rock, with very well preserved area; Fig. 11, a cast of the large valve with the septal lamellæ. Figs. 12,13, forms from the Rajhoti Pass (the septa in the large valve in Fig. 13 drawn too short, cf. Fig. 11); Fig. 14, from Lilang, a little compressed and therefore appearing particularly wide.

„ 15, 16. Spiriferina (Mentzelia) Kœveskalliensis (Suess) Bœckh., p. 21, *viz.*, Fig. 15, var. *Microrhyncha*, Bittn., from Silakank; Fig. 16, *var. Spitiensis*, Stol., from Lilang (original of Stoliczka's *Spiriferina Spitiensis*).

„ 17, 18. Retzia himaica, nov. sp., p. 22, from the beds of *Rhynchonella Griesbachi*, m. in Rimkin-Paiar.

Geol. Surv. of India. HIMALAYAN TRIAS BRACHIOPODA, LAMELLIBRANCHIATA ETC. Pl. IV.



A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE V.

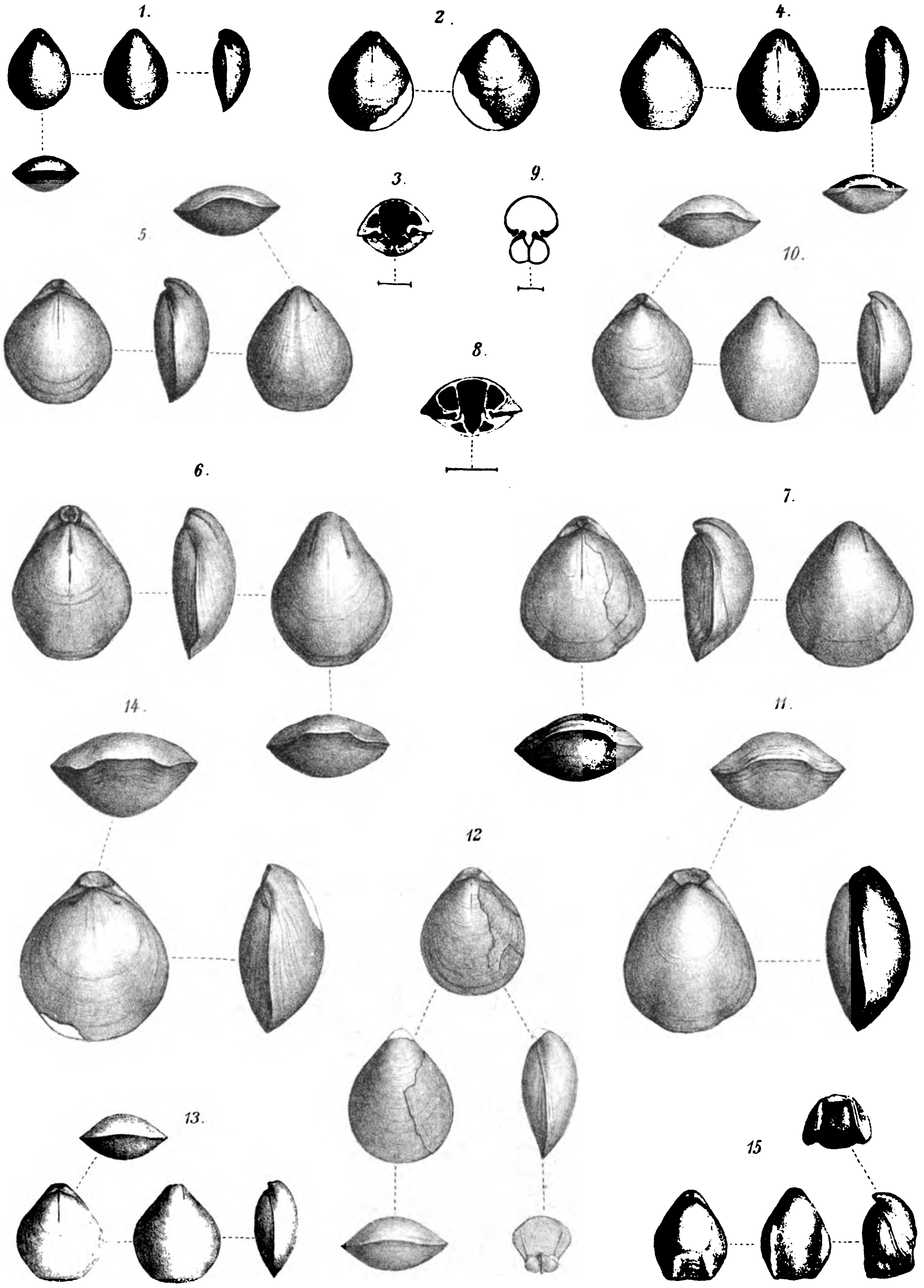
Figs. 1-8, 10, 11. **Terebratula (Dielasma) Himalayana**, nov. sp., p. 25 mostly from the horizon of *Spiriferina Stracheyi.* Figs. 1-3, from Rimkin-Paiar (collected by Diener, 26th August 1892), Fig. 1, a form with the shell with lateral striaton, Fig. 2, a cast, Fig. 3, a section through the cardinal area; Figs. 4, 5, 6, 8, from Rimkin-Paiar, S. E. (collected by Diener, 2nd September 1892), Fig. 4 with the shell preserved on the small valve, Figs. 5, 6, casts, Fig. 8, a section through the cardinal area (in Fig. 9 a section through the cardinal area of the Alpine *Coenothyris vulgaris* from a North Alpine locality added for comparison); Fig. 7 likewise from Rimkin-Paiar, but from the "Upper Muschelkalk" (collected 27th August, 1892); Figs. 10, 11, from Lilang, on the Lingti River in Spiti.

" 12, 13. **Terebratula aff. Himalayanae**, nov. sp., p. 27, from the "Upper Muschelkalk," *viz.*, Fig. 12, from Rimkin-Paiar (collected 29th August 1892), Fig. 13, from S. E. of Muth, in Spiti.

Fig. 14. **Terebratula**, cf. **vulgaris**, Schloth., sp., p. 28, from Lilang, in Spiti.

" 15. **Rhynchonella Theobaldiana**, Stol. p. 17, Stoliczka's original specimen from Muth in the Pin Valley, Spiti.

Geol. Surv. of India. **HIMALAYAN TRIAS BRACHIOPODA, LAMELLIBRANCHIATA ETC.** Pl. V.



A. Swoboda del. et lith.

Th. Bannwarth print.

PLATE VI.

Fig. 1. **Aulacothyris Lilangensis**, nov. sp., p. 28, from Lilang on the Lingti, Spiti; described and figured by Stoliczka as *Rhynchonella retrocita*, Suess, var. *angusta*, Stol. (Stoliczka's original specimen).

Figs. 2, 17, 18. **Rhynchonella (Norella) Tibetica**, nov. sp., p. 32, from the horizon of *Daonella indica*, m., at the upper boundary of the Muschelkalk complex. Fig. 2, from the Shalshal Cliff, near Rimkin-Paiar (the specimen was more completely developed only after it had been figured and then recognised as a Rhynchonella; it does not possess a Terebratula beak, as is shown in the figure); Figs. 17, 18, from Dogkwa Aúr in the Hop-Gadh district.

" 3-7. **Aulacothyris Nilangensis**, nov. sp., p. 30, from the horizon of *Daonella indica*, *viz.*, Figs. 3, 4, from the Shalshal section near Rimkin-Paiar, Figs. 5-7, from Dogkwa Aúr meadow in Hop-Gadh. The most abundant species of brachiopods in this horizon.

" 8-13. **Spirigera hunica**, nov. sp., p. 31, from the horizon of *Daonella indica* and *Aulacothyris Nilangensis*. Figs. 8, 9, smaller, doubtful specimens; Figs. 10, 11, larger specimens to be assigned with certainty to this species; the largest typical specimen hitherto known, represented in Fig. 13; Fig. 12, a wider, accessory form. All the specimens are from Dogkwa Aúr Encamping Ground, in the Hop-Gadh district, Tibet.

" 14, 15, 16. **Rhynchonella (Norella) Kingi**, nov. sp., p. 32, from the horizon with *Daonella Indica*, in the Shalshal Cliff, near Rimkin-Paiar (cf. also Pl. II, Fig. 16).

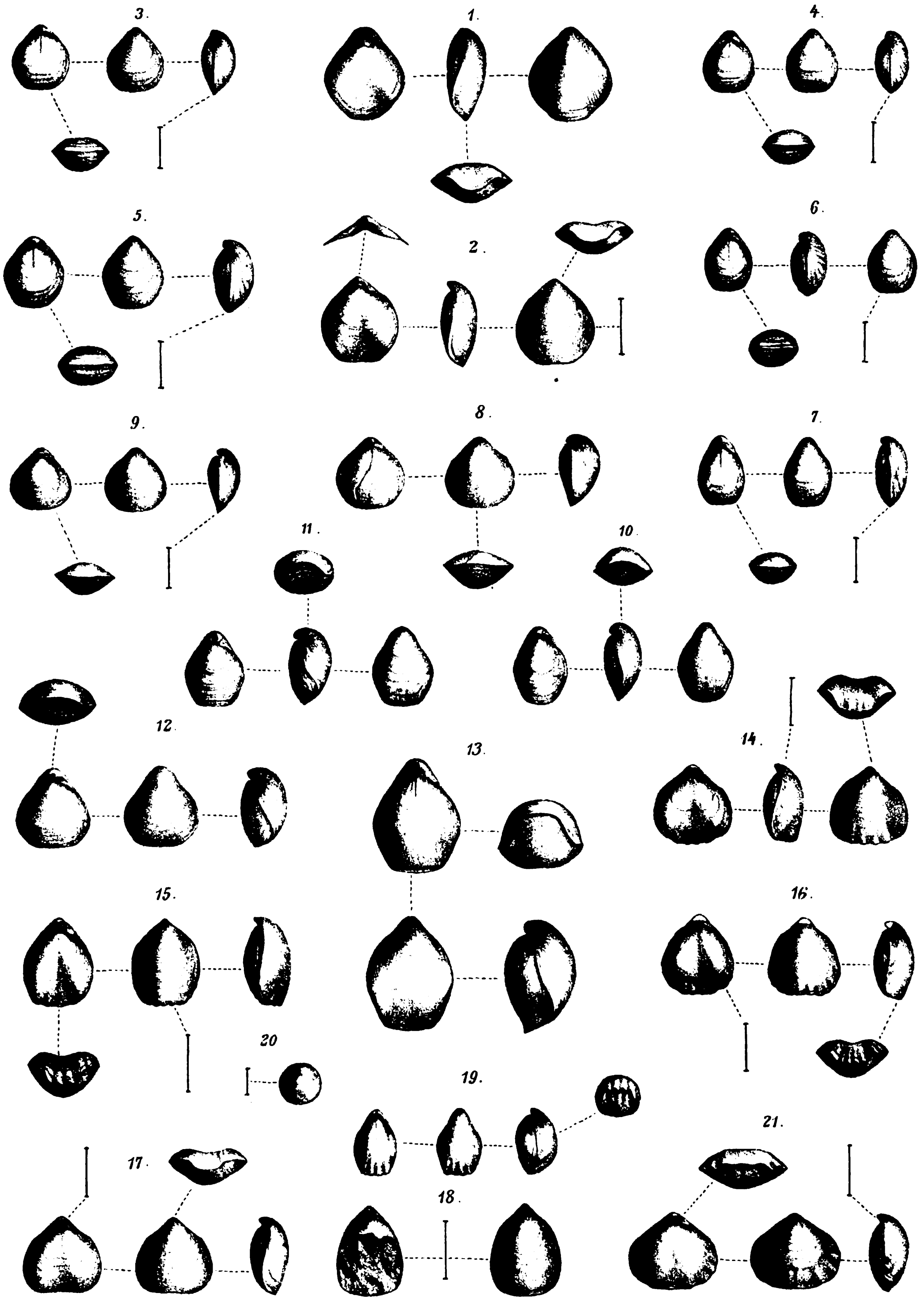
" 17, 18. (See above, Fig. 2).

Fig. 19. **Rhynchonella Rimkinensis**, nov. sp., p. 33, from the grey crinoidal limestone, immediately underlying the horizon of *Daonella indica* in the Shalshal section near Rimkin-Paiar.

" 20. **Discina**, sp., p 33, from the horizon of *Daonella indica* from Dogkwa Aúr Encamping Ground, Tibet.

" 21. **Rhynchonella Middlemissii**, nov. sp., p. 68, from the red limestone of the Cliff of Chitichun in Tibet.

HIMALAYAN TRIAS BRACHIOPODA, LAMELLIBRANCHIATA ETC.



A. Swoboda del. et lith.
Th. Bannwarth print.

PLATE VII.

Figs. 1, 2. **Daonella cf. Lommeli**, Wissm. sp., p. 33, from S. E. of Muth in the Pin Valley, Spiti, collected by Griesbach, both forms from the same specimen of rock.

Fig. 3. **Daonella Spitiensis**, nov. sp., p. 38, from Kuling in the Pin Valley, Spiti.

Figs. 4-11. **Daonella indica**, nov. sp., p. 39, from the horizon of that name at the upper boundary of the Muschelkalk complex. Figs. 4-9, from Dogkwa Aúr Encamping Ground, in the Hop-Gadh district, Tibet; Fig. 10 from the Shalshal Cliff, near Rimkin-Paiar; Fig. 11 from Khar in the Pin Valley, Spiti.

Fig. 12. **Daonella aff. indica**, nov. sp., p. 41, from Kuling in the Pin Valley, Spiti.

„ 13. **Halobia comata**, nov. sp., p. 46, from the so-called "Daonella-beds" of the Bambanag section in the Girthi Valley. The ribbing is shown a little too coarsely in the drawing.

„ 14. **Halobia cf. comata**, nov. sp., p. 47, from the same locality as Fig. 13, but from younger beds in the section.

„ 15. **Halobia fascigera**, nov. sp., p. 45, from the lower beds of the so-called "Daonella beds" of the Bambanag section in the Girthi Valley. The bundle-like arrangement of the ribs is not brought out with sufficient distinctness in the illustration.

„ 16. **Halobia**, spec., p. 47, from the higher beds of the so-called "Daonella beds" in the Shalshal section, near Rimkin-Paiar.

Figs. 17, 18, 19. **Avicula (?) Girthiana**, nov. sp., p. 48, from the so-called " Daonella beds" of the Bambanag section in the Girthi Valley.

Fig. 20. **Lima** sp., p. 50, from a black limestone bed with *Halobia* cf. *comata*, nov. sp., from N. W. of Kiunglung.

„ 21. **Myoconcha**, sp., p. , from the crinoidal limestone beneath the beds with *Daonella indica*, in the Shalshal section, near Rimkin Paiar.

HIMALAYAN TRIAS BRACHIOPODA, LAMELLIBRANCHIATA ETC.

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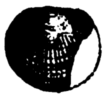

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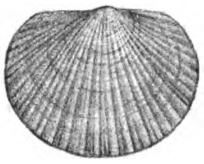

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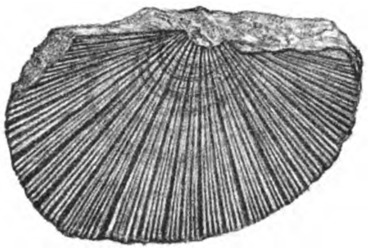

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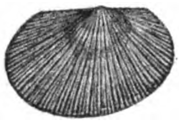

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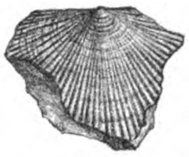

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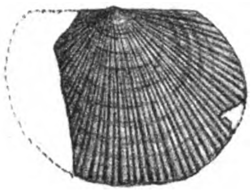

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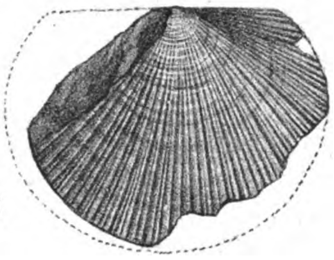

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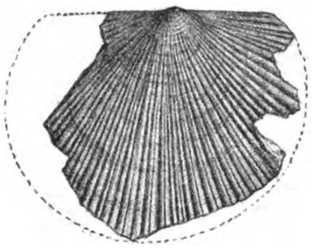

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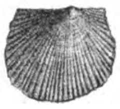

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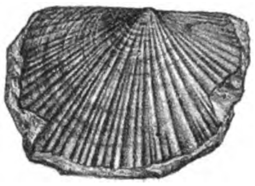

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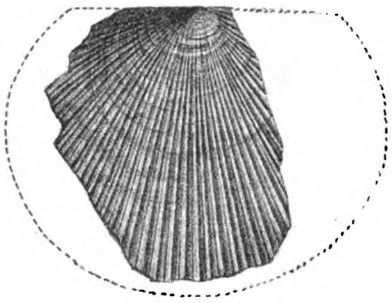

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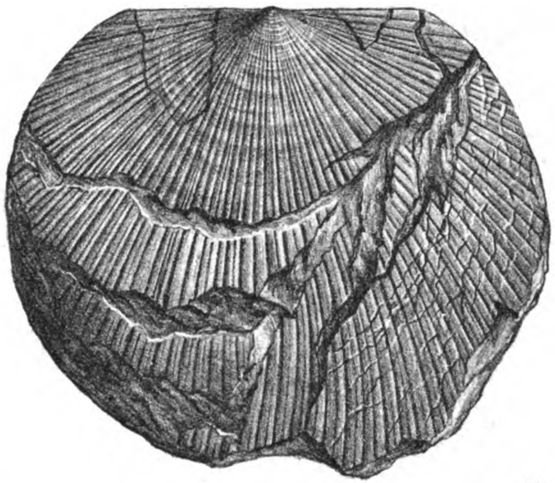

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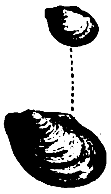

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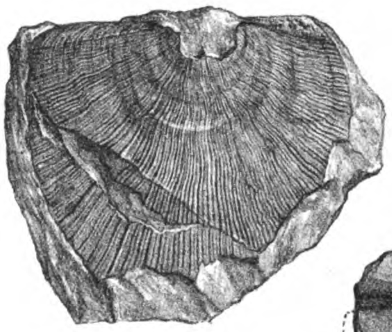

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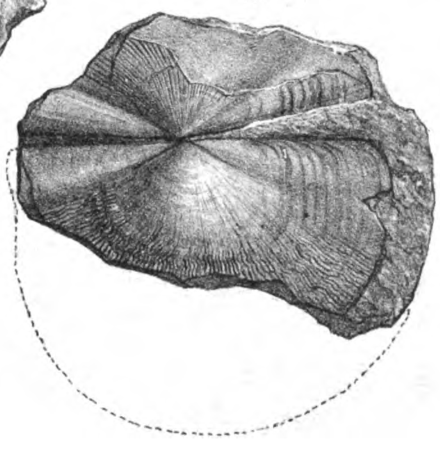

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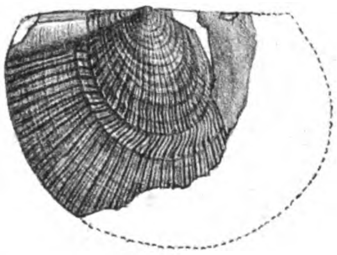

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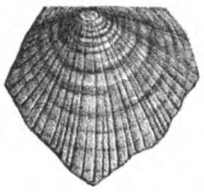

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A. Swoboda del. et lith.

Th. Bannwarth print.

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PLATE VIII.

Figs. 1-3. Retzia Schwageri, Bittn., var. Asiatica, nov., p. 42, from the complex of the "Daonella beds" of Lauka Encamping Ground (Figs. 2, 3), and from the Bambanag section (Fig. 1). Cf. also Pl. X, Figs. 16-21.

Fig. 4. Rhynchonella Bambanagensis, nov. sp., p. 44, from the "Hauerites beds" of the Bambanag section. Cf. also Pl. IX, Fig. 18.

Figs. 5, 6. Rhynchonella Laucana, nov. sp., p. 44, from the so-called "Daonella beds" of Lauka Encamping Ground, in the highest part of the Girthi Valley.

„ 7, 8, 9. Cassianella, pl. sp., p. 49, *viz.* Figs. 7, 8, from the so-called "Daonella beds" of the Bambanag section; Fig. 9 from the Shalshal section, near Rimkin-Paiar.

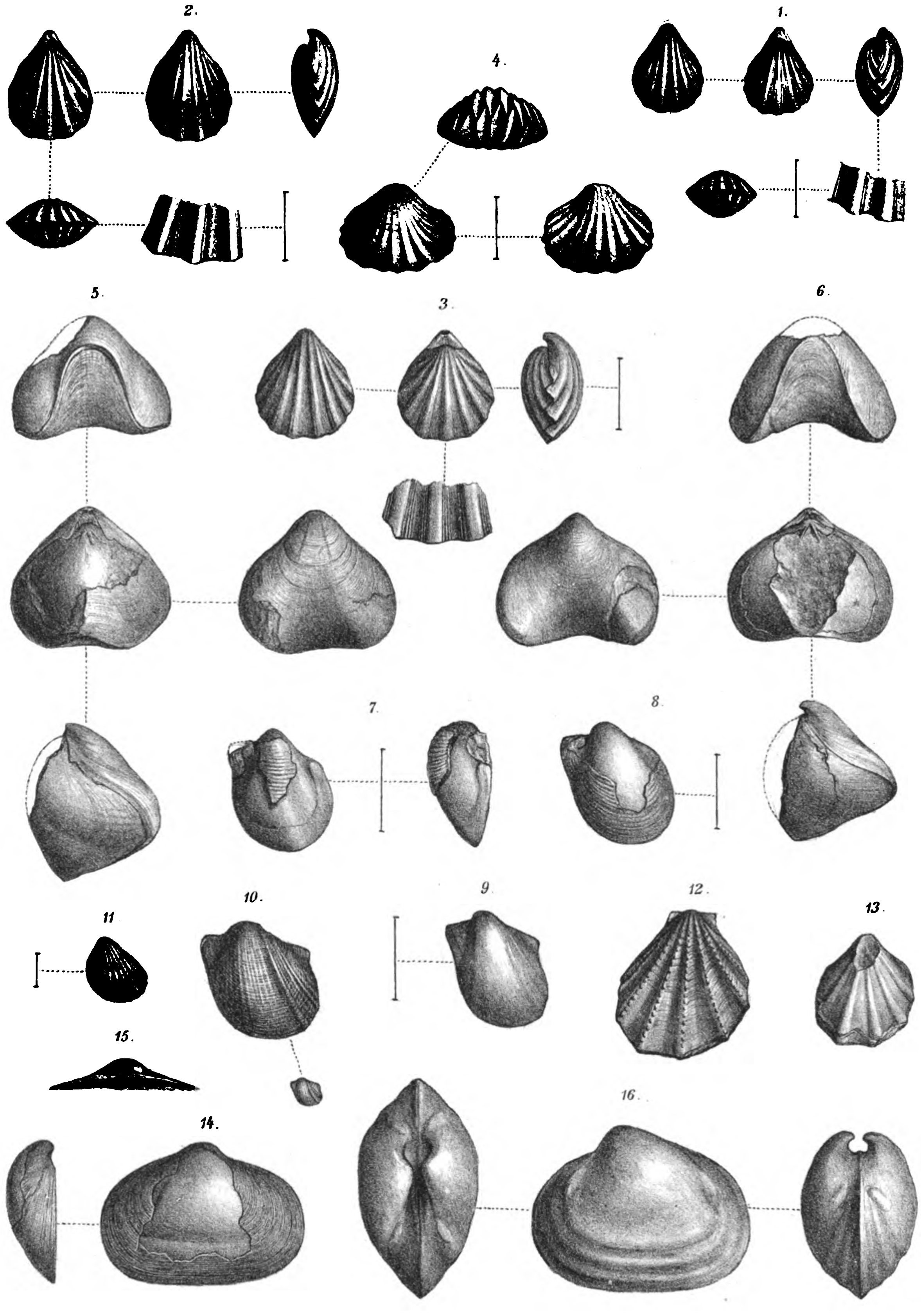
Fig. 10. Cassianella pulchella, nov. sp., p. 58, from the horizon of *Spiriferina Griesbachi* of the Bambanag section.

„ 11. Lima, sp., p. 50, from the Halorites beds in the Bambanag section of the Girthi Valley.

Figs. 12, 13. Lima (?) serraticosta, nov. sp., p. 50, from the Halorites (Tropites) beds of the Bambanag section. Fig. 12, specimen with the shell; Fig. 13, cast; cf. also Pl. X, Fig. 26.

„ 4-16. Anodontophora (Anoplophora, auct.) Griesbachi, nov. sp. p. 60, *viz.* Figs. 14, 15, forms with the shell, from the Halorites (Tropites) beds of the Bambanag section; Fig. 16, a cast from the "Sagenites beds" overlying the horizon with *Spiriferina Griesbachi.*

HIMALAYAN TRIAS BRACHIOPODA, LAMELLIBRANCHIATA ETC.



A. Swoboda del. et lith.
Th. Bannwarth print.

PLATE IX.

Figs.	1-7.	**Spiriferina Griesbachi**, nov. sp., p. 51, from the Bambanag section.
"	8-13.	**Spiriferina Tibetica**, Stol. p. , from the Manirang Pass in Spiti, *viz.*, Fig. 8, view of the area; Fig. 9, external view of a large valve; Fig. 10, section of the beak parallel to the area; Fig. 11, external section of the beak; Fig. 12, dental plates in the beak in complete preservation; Fig. 13, median septum of the beak.
"	14, 15.	**Spiriferina tibetica**, Stol. sp., pp. 52, 53, Stoliczka's two original specimens.
Fig.	16.	**Spiriferina altivaga**, Stol. sp., p. 53, Stoliczka's original specimen.
"	17.	**Rhynchonella Martoliana**, nov. sp., p. 56, from the horizon of *Spiriferina Griesbachi* in the Bambanag section, near Martoli Encamping Ground.
"	18.	**Rhynchonella Bambanagensis**, nov. sp., p. 56, from the horizon of *Spiriferina Griesbachi* in the Bambanag section (cf. also Pl. VIII, Fig. 4).
Figs.	19, 20.	**Aulacothyris Joharensis**, nov. sp., p. 57, from the horizon of *Spiriferina Griesbachi* of the Bambanag section in the Girthi Valley.

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Pl. IX.

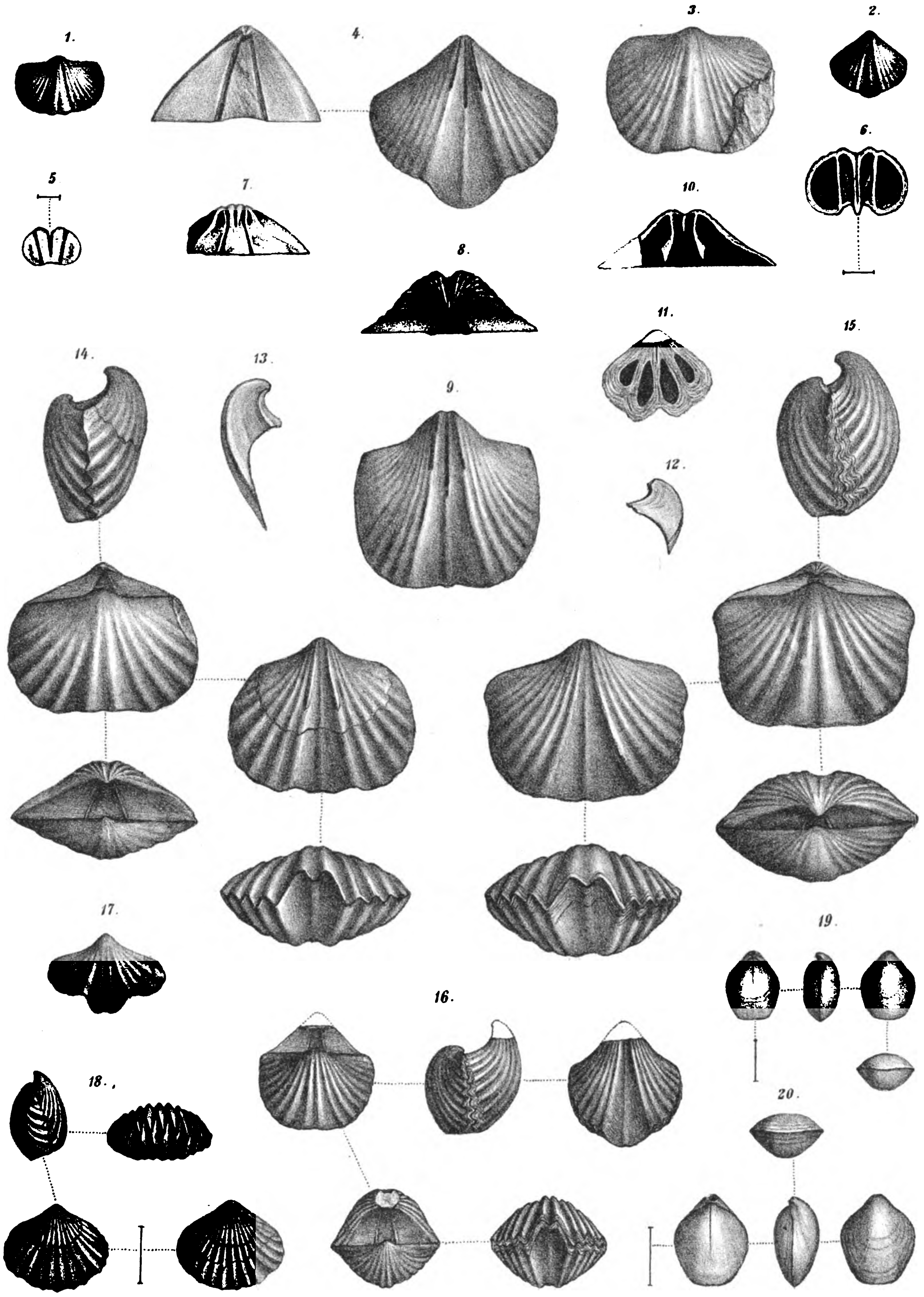

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PLATE X.

Figs. 1-14. **Spirigera Dieneri**, nov. sp., p. 54, from the horizon of *Spiriferina Griesbachi* of the Bambanag section; Figs. 1-11, the species in different stages of growth and varieties (Fig. 11 is enlarged one and a half times). Figs 12, 13, sections of the umbones; Fig. 14, section of the umbo of the small valve parallel to the line of junction of the two valves.

Fig. 15. **Amphiclina**, sp., p. 55, from the beds with *Spiriferina Griesbachi* of the Bambanag section.

Figs. 16-21. **Retzia Schwageri**, Bittn., var. **Asiatica**, nov., p. 54 (cf also Pl. VIII, Figs. 1-3) from the beds with *Spiriferina Griesbachi* of the Bambanag section. Fig. 17, an abnormal specimen, Fig. 21, the region of the area enlarged.

Fig. 22. **Pecten interruptus**, nov. sp., p. 60, from the beds with *Spiriferina Griesbachi* of the Bambanag section.

Figs. 23, 24. **Pecten biformatus**, nov. sp., p. 59, from the beds with *Spiriferina Griesbachi* of the Bambanag section. Both valves, but the drawing of the left valve (Fig. 24) is not quite correct.

Fig. 25. **Lima cumaunica**, nov., sp., p. 59, from the beds with *Spiriferina Griesbachi* of the Bambanag section.

" 26. **Lima (?) serraticosta**, nov. sp. (?), p. 51, from the "Sagenites beds" in the Bambanag section (cf. Pl. VIII, Figs. 12, 13).

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Pl. X.

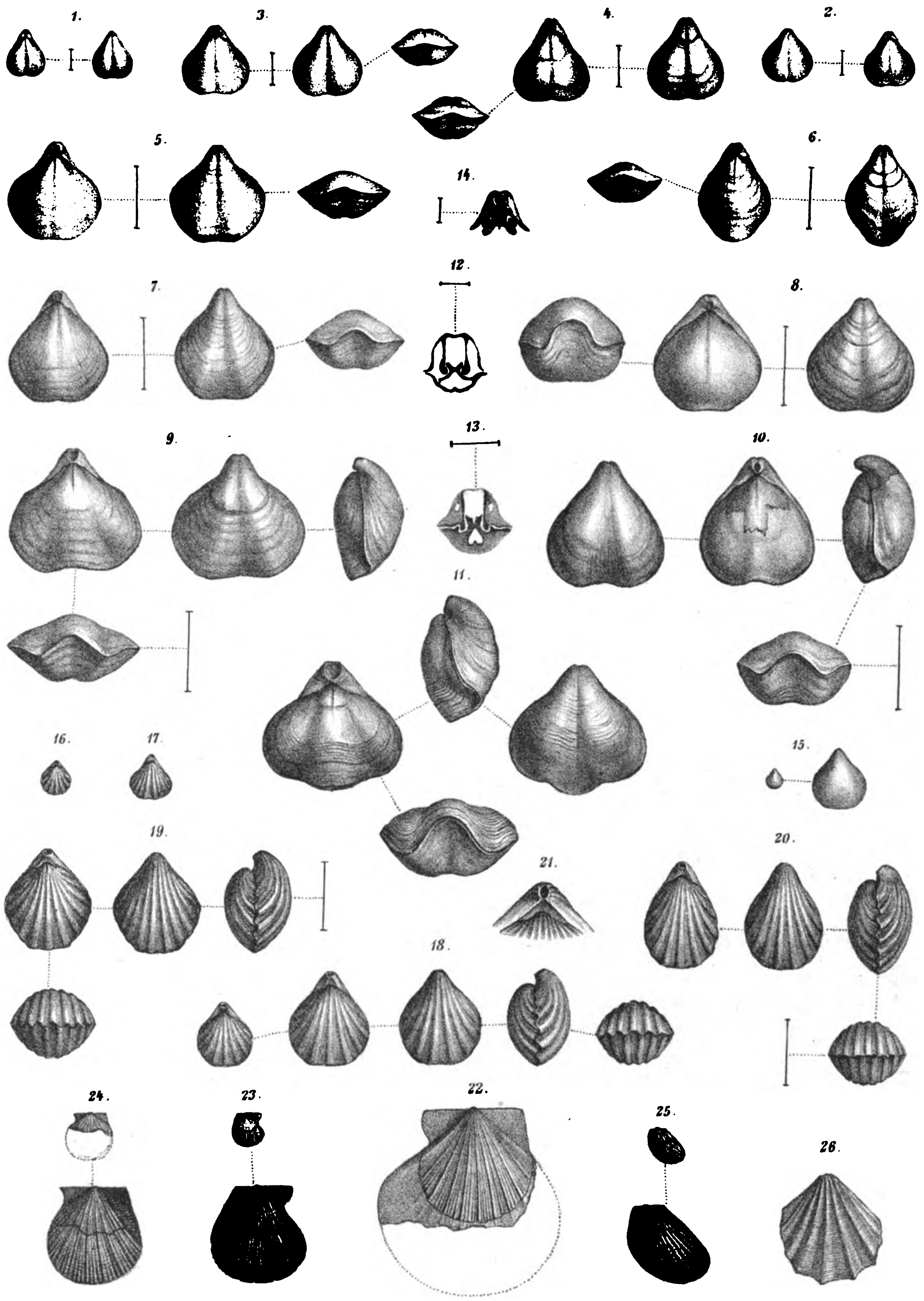

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PLATE XI.

Fig. 1. MEGALODON CULTRIDENS, nov. sp., p. 62, from the vicinity of Lingti-Sumdo (Tibet ?). Fig. 1, the front view of the cast; 1^a the back view of the right umbo, 1^b lateral aspect of cast of the right umbo with the anterior part of the shell adherent to it; 1^c the hinge of the two valves, that of the right valve restored from a plaster cast of its mould; 1^d the hinge teeth of the left valve seen from the lunule. All the views from the same specimen.

Figs. 2, 3. SPIRIGERA (?) NOETLINGII, nov. sp., p. 68, from beds of unknown age (presumably Lias) from Nio-Sumdo, in Karnag. Fig. 2, the front view is represented as reversed through a mistake on the part of the draughtsman. Fig. 3, cut and polished section with the arm spiral of one side, which is displaced in the shell.

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PLATE XII.

Fig. 1. **Dicerocardium Himálayense**, Stol., p. 66, from the so-called "Para limestone" from the village of Chiote in North-Western Spiti. Stoliczka's original specimen. Fig. 1a, back view; 1b, front view, 1c, lateral view, 1d, a portion of the left umbo broken off.

„ 2. **Megalodon Ladakhensis**, nov. sp., p. 65, from Ladakh, or from Spiti. Original specimen of Lydekker's illustration on Pl. 4, in Mem. Geol. Surv. of India. Vol. XXII, here reduced to about one-third the natural size.

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